



Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017



GBD 2017 Causes of Death Collaborators*

Summary

Background Global development goals increasingly rely on country-specific estimates for benchmarking a nation's progress. To meet this need, the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2016 estimated global, regional, national, and, for selected locations, subnational cause-specific mortality beginning in the year 1980. Here we report an update to that study, making use of newly available data and improved methods. GBD 2017 provides a comprehensive assessment of cause-specific mortality for 282 causes in 195 countries and territories from 1980 to 2017.

Methods The causes of death database is composed of vital registration (VR), verbal autopsy (VA), registry, survey, police, and surveillance data. GBD 2017 added ten VA studies, 127 country-years of VR data, 502 cancer-registry country-years, and an additional surveillance country-year. Expansions of the GBD cause of death hierarchy resulted in 18 additional causes estimated for GBD 2017. Newly available data led to subnational estimates for five additional countries—Ethiopia, Iran, New Zealand, Norway, and Russia. Deaths assigned International Classification of Diseases (ICD) codes for non-specific, implausible, or intermediate causes of death were reassigned to underlying causes by redistribution algorithms that were incorporated into uncertainty estimation. We used statistical modelling tools developed for GBD, including the Cause of Death Ensemble model (CODEm), to generate cause fractions and cause-specific death rates for each location, year, age, and sex. Instead of using UN estimates as in previous versions, GBD 2017 independently estimated population size and fertility rate for all locations. Years of life lost (YLLs) were then calculated as the sum of each death multiplied by the standard life expectancy at each age. All rates reported here are age-standardised.

Findings At the broadest grouping of causes of death (Level 1), non-communicable diseases (NCDs) comprised the greatest fraction of deaths, contributing to 73·4% (95% uncertainty interval [UI] 72·5–74·1) of total deaths in 2017, while communicable, maternal, neonatal, and nutritional (CMNN) causes accounted for 18·6% (17·9–19·6), and injuries 8·0% (7·7–8·2). Total numbers of deaths from NCD causes increased from 2007 to 2017 by 22·7% (21·5–23·9), representing an additional 7·61 million (7·20–8·01) deaths estimated in 2017 versus 2007. The death rate from NCDs decreased globally by 7·9% (7·0–8·8). The number of deaths for CMNN causes decreased by 22·2% (20·0–24·0) and the death rate by 31·8% (30·1–33·3). Total deaths from injuries increased by 2·3% (0·5–4·0) between 2007 and 2017, and the death rate from injuries decreased by 13·7% (12·2–15·1) to 57·9 deaths (55·9–59·2) per 100 000 in 2017. Deaths from substance use disorders also increased, rising from 284 000 deaths (268 000–289 000) globally in 2007 to 352 000 (334 000–363 000) in 2017. Between 2007 and 2017, total deaths from conflict and terrorism increased by 118·0% (88·8–148·6). A greater reduction in total deaths and death rates was observed for some CMNN causes among children younger than 5 years than for older adults, such as a 36·4% (32·2–40·6) reduction in deaths from lower respiratory infections for children younger than 5 years compared with a 33·6% (31·2–36·1) increase in adults older than 70 years. Globally, the number of deaths was greater for men than for women at most ages in 2017, except at ages older than 85 years. Trends in global YLLs reflect an epidemiological transition, with decreases in total YLLs from enteric infections, respiratory infections and tuberculosis, and maternal and neonatal disorders between 1990 and 2017; these were generally greater in magnitude at the lowest levels of the Socio-demographic Index (SDI). At the same time, there were large increases in YLLs from neoplasms and cardiovascular diseases. YLL rates decreased across the five leading Level 2 causes in all SDI quintiles. The leading causes of YLLs in 1990—neonatal disorders, lower respiratory infections, and diarrhoeal diseases—were ranked second, fourth, and fifth, in 2017. Meanwhile, estimated YLLs increased for ischaemic heart disease (ranked first in 2017) and stroke (ranked third), even though YLL rates decreased. Population growth contributed to increased total deaths across the 20 leading Level 2 causes of mortality between 2007 and 2017. Decreases in the cause-specific mortality rate reduced the effect of population growth for all but three causes: substance use disorders, neurological disorders, and skin and subcutaneous diseases.

Lancet 2018; 392: 1736–88

This online publication has been corrected. The corrected version first appeared at thelancet.com on November 9, 2018

*Collaborators listed at the end of the paper

Correspondence to: Dr Gregory Roth, Institute for Health Metrics and Evaluation, Seattle, WA 98121, USA rothg@uw.edu

Interpretation Improvements in global health have been unevenly distributed among populations. Deaths due to injuries, substance use disorders, armed conflict and terrorism, neoplasms, and cardiovascular disease are expanding threats to global health. For causes of death such as lower respiratory and enteric infections, more rapid progress occurred for children than for the oldest adults, and there is continuing disparity in mortality rates by sex across age groups. Reductions in the death rate of some common diseases are themselves slowing or have ceased, primarily for NCDs, and the death rate for selected causes has increased in the past decade.

Funding Bill & Melinda Gates Foundation.

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Introduction

Systematic recording and analysis of causes of human death remains one of the most resilient successes for public health, beginning with routine and continuous reporting of deaths by physicians starting in the 15th century.¹ Today, hundreds of thousands of physicians evaluate and select the cause of death for millions of deaths annually, codifying the results according to the International Classification of Diseases (ICD) system.² These efforts form the basis of a global mortality reporting system that is widely relied upon to prioritise

health system investments, track progress towards global development goals, and guide scientific research. Although there remains a need for wider adoption and improvement of these systems, continuous reporting of cause-specific mortality in many countries represents a success for global health.³

More mortality data are now becoming available because of broader adoption of vital registration systems and increased information-sharing made possible by digital communication. At the same time, efforts to correct, sort, analyse, and report this massive

Research in context

Evidence before this study

Previously, the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2016 provided estimates for 264 causes of death for 195 countries and territories, by age and sex, from 1980 to 2016. GBD 2016 incorporated newly available data for many locations, expanded and refined the included causes of death, improved modelling techniques, and developed a star rating system for the quality of cause of death data. To better assess mortality among the oldest adults, terminal age categories for age 90–94 years and 95 years and older were added. Other organisations periodically produce estimates of cause-specific mortality, including for a wide list of causes and across multiple age groups (WHO), for selected cancers (the International Agency for Research on Cancer), and for child deaths (the Maternal and Child Epidemiology Estimation [MCEE] group). GBD continues to provide the only peer-reviewed annual estimates of cause-specific mortality available for all locations over time.

Added value of this study

GBD 2017 includes estimates for 2017 and also updates the entire series from 1980 produced for GBD 2016. The list of included causes has been expanded and study methods have been improved in multiple ways. First, inclusion of an independent estimation of population and fertility developed for GBD 2017 substantially improved estimates in selected countries. Second, additional data were identified, including 127 country-years of vital registration and ten verbal autopsy studies. Third, new subnational assessments were developed for five countries in 2017: Ethiopia, Iran, New Zealand, Norway, and Russia. Fourth, a new stratum was developed for subnational-level estimation in New Zealand to characterise populations by ethnicity as Māori or non-Māori. Fifth, we

revised adjustments made for misclassified deaths due to dementia, Parkinson's disease, and atrial fibrillation. Finally, additional diseases are now estimated, including non-rheumatic calcific aortic and degenerative mitral valve disease; subarachnoid haemorrhage; myelodysplastic, myeloproliferative, and other haemopoietic disorders; diabetes mellitus as type 1 and type 2 (previously combined); poisoning by carbon monoxide; liver cancer due to non-alcoholic steatohepatitis; ectopic pregnancy; and invasive non-typhoidal salmonella.

Implications of all the available evidence

Deaths due to communicable, maternal, neonatal, and nutritional causes continue to decline, while deaths from non-communicable diseases increase and injury deaths are stable. Declines in death rates of some non-communicable diseases have slowed or ceased. GBD 2017 has increased its collaboration with governments, leading to additional data for subnational estimation. Engagement with GBD collaborators, policy makers, disease experts, and the public is guiding expansions of the cause list and resulting decreasing burden classified in residual "other" categories. Non-communicable diseases remain the leading causes of death globally, and their burden is rising. GBD 2017 is motivated by the same goals as GBD 2016, including the belief that annual updates, reflecting improvements due to improved data availability, new causes estimated, and better methods to reduce bias and improve transparency in reporting, are contributing to the formulation and tracking of new evidence-based health policy. We intend for GBD 2017 to serve as a global public good, freely available for policy makers and the public seeking to improve human health.

amount of global data are evolving to keep pace with increasing demands for timely assessment of global, regional, and local mortality patterns. In addition to shifts in mortality patterns due to an ongoing epidemiological transition, rapid spikes in mortality due to specific causes are frequently observed and require recurrent updates to global estimates. Examples of mortality spikes include opioid-associated deaths in parts of the USA,⁴ suicide in eastern Europe in the 1990s,⁵ and conflict-associated deaths in the eastern Mediterranean and North Africa region.⁶ Causes of death are now reported digitally in many locations, allowing health authorities to improve the quality and timeliness of mortality reporting.^{7,8} Global development goals increasingly rely on country-specific estimates for benchmarking a nation's progress. Global commitments, such as the UN's Sustainable Development Goals (SDGs),⁹ the Moscow Declaration to End Tuberculosis,¹⁰ WHO's First Global Conference on Air Pollution and Health¹¹ in October, 2018, and the UN High-level Meetings on NCDs¹² and tuberculosis,¹³ both in September, 2018, will require ongoing tracking of cause-specific mortality, including in locations where mortality surveillance data remain limited.

See Online for appendix 2

The following study represents an annual update to the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD), an effort to produce consistent and comparable estimates of cause-specific mortality for all locations globally. GBD 2017 includes results by age and sex, for the years 1980 through to 2017, for 195 countries and territories. A cycle of continuous quality improvement has led to substantial changes, including new data sources, new causes of death, and updated methods. For the first time, population estimates have been independently produced by GBD 2017,¹⁴ and subnational estimates have been produced for Ethiopia, Iran, New Zealand, Norway, and Russia. The purpose of GBD 2017 is to serve as a global public good, freely available for policy makers and the public seeking to improve human health.

For the data visualisation tool see <https://vizhub.healthdata.org/gbd-compare/>

Methods

Overview

GBD cause of death estimation incorporates methods to adjust for incomplete or missing vital registration (VR) and verbal autopsy (VA) data, general heterogeneity in data completeness and quality, and the redistribution of so-called garbage codes (insufficiently specific or implausible cause of death codes). A general description of these methods is provided in this section, with further detail presented in appendix 1. GBD 2017 complied with the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER)¹⁵ statement (appendix 1 section 1.3). Analyses were completed with Python version 2.7.14, Stata version 13.1, and R version 3.3.2. Statistical code used for GBD estimation is publicly available online.

See Online for appendix 1

For the statistical code see <https://github.com/ihmeuw/ihme-modeling>

Geographical units and time periods

The locations included in GBD 2017 have been arranged into a set of hierarchical categories composed of seven super-regions and a further nested set of 21 regions containing 195 countries and territories (appendix 1). Each year, GBD includes subnational analyses for a few new countries and continues to provide subnational estimates for countries that were added in previous cycles. Subnational estimation in GBD 2017 includes five new countries (Ethiopia, Iran, New Zealand, Norway, Russia) and countries previously estimated at subnational levels (GBD 2013: China, Mexico, and the UK [regional level]; GBD 2015: Brazil, India, Japan, Kenya, South Africa, Sweden, and the USA; GBD 2016: Indonesia and the UK [local government authority level]). All analyses are at the first level of administrative organisation within each country except for New Zealand (by Māori ethnicity), Sweden (by Stockholm and non-Stockholm), and the UK (by local government authorities). All subnational estimates for these countries were incorporated into model development and evaluation as part of GBD 2017. To meet data use requirements, in this publication we present all subnational estimates excluding those pending publication (Brazil, India, Japan, Kenya, Mexico, Sweden, the UK, and the USA); because of space constraints these selected subnational results are presented in appendix 2. Subnational estimates for countries with populations larger than 200 million (measured with our most recent year of published estimates) that have not yet been published elsewhere are presented wherever estimates are illustrated with maps but are not included in data tables.

The complete cause-specific estimation results include the years 1980 through to 2017, and are available for exploration by an online data visualisation tool. To better support current health policy assessment, we include a subset of analyses in the current study featuring the most recent interval, 2007–17.

The GBD cause of death hierarchy

The GBD study attributes each death to a single underlying cause that began the series of events leading to death, in accordance with ICD principles. The GBD study organises causes of death in a hierarchical list containing four levels (appendix 1 section 7). At the highest level (Level 1), all disease burden is divided among three mutually exclusive and collectively exhaustive categories: communicable, maternal, neonatal, and nutritional (CMNN) diseases; non-communicable diseases (NCDs); and injuries. Level 2 distinguishes these Level 1 categories into 21 cause groups, such as cardiovascular diseases; diarrhoeal diseases, lower respiratory infections (LRIs), and other common infectious diseases; or transport injuries. Level 3 disaggregates these causes further; in most cases this disaggregation represents the finest level of detail by cause, such as stroke, ischaemic heart disease,

or road injuries. Where data are sufficiently available or specific policy relevance has been sought, selected causes are further disaggregated at Level 4, such as drug-susceptible tuberculosis, multidrug-resistant tuberculosis without extensive drug resistance, and extensively drug-resistant tuberculosis. For GBD 2017, the cause hierarchy was further refined to separately estimate causes with substantial policy interest or high levels of burden. Specific changes included separate estimation of non-rheumatic calcific aortic and degenerative mitral valve diseases, and myelodysplastic, myeloproliferative, and other haemopoietic neoplasms, resulting in a reduction in the estimates of some residual causes. Disaggregation of residual causes also allowed separate estimation of type 1 and type 2 diabetes, chronic kidney disease due to type 1 and type 2 diabetes, poisoning by carbon monoxide, liver cancer due to non-alcoholic steatohepatitis (NASH), subarachnoid haemorrhage, ectopic pregnancy, and invasive nontyphoidal salmonella. Maternal and neonatal disorders, previously estimated as separate cause groupings at Level 2 of the hierarchy, were estimated for GBD 2017 at Level 3 of the hierarchy, and then aggregated up to Level 2 to better capture the epidemiological connections and linked burden between them. The complete hierarchy of causes included in GBD 2017 and their corresponding ICD9 and ICD10 codes are described in appendix 1 (section 7).

Cause of death data

The GBD cause of death database consists of VR and VA data; survey and census data for injuries and maternal mortality; surveillance data for maternal mortality and child death; cancer registries; and police records for interpersonal violence and road injuries. Self-harm estimates incorporate VR data and are based on ICD categorisation as described in appendix 1 (section 7). In this iteration of GBD, ten new VA studies and 127 new country-years of VR data were added at the country level. 502 new cancer-registry country-years were added, as was one additional new surveillance country-year. Data sources comprising the GBD cause of death database can be reviewed on the Global Health Data Exchange website. Multiple factors can influence changes between GBD studies in estimates for a given cause-location-year, including the quality of a country's data system (as represented by the GBD star rating system) and the addition of more recent data. Figure 1 shows the relative stability of GBD estimates between study iterations. Variation between GBD 2016 and GBD 2017 estimates was greater in countries with both low star ratings and no new VR data updates occurring between these iterations of the study. Changes to estimates can be seen even in high star rating locations because of changes in modelling strategy or model covariates even when no new VR data were available between cycles.

Data standardisation and processing

To standardise cause of death data, we used protocols to address the minor proportion of deaths that were assigned to age groups broader than the GBD five-year age groups or were not assigned an age or sex, and to address differences in ICD codes due to national variation or revision, as described in appendix 1 (section 2). Garbage codes, deaths with non-specific codes (eg, unspecified stroke), deaths assigned to ICD codes that could not be underlying causes of death (eg, senility), or deaths assigned to intermediate but not underlying causes of death (eg, heart failure), were redistributed by age, sex, location, and year to the most likely causes of death. Methods used for this redistribution included regression models, redistribution based on fixed proportions, proportional reassignment, and fractional assignment of a death assigned to multiple causes, as developed by Naghavi and colleagues¹⁶ and detailed in appendix 1 (section 2.7). We excluded all data sources with more than 50% of deaths assigned to major garbage codes (those at Level 1 or Level 2 of the GBD hierarchy) in any location-year to mitigate the potential for bias from these sources. The proportion of VR data assigned to major garbage code categories for each location-year is shown, with supporting detail, in appendix 1 (section 7). New to GBD 2017, the uncertainty around redistribution methods was also estimated. Additional details for this process are provided in appendix 1 (section 2.7). Because mortality due to HIV/AIDS is sometimes coded to other causes of death such as tuberculosis, meningitis, or toxoplasmosis, we also corrected the cause of death assignment to HIV/AIDS for peak epidemic times. Tuberculosis deaths can be misclassified as pneumonia deaths in children in locations with a high tuberculosis burden. Methods to adjust for this potential misclassification are described in detail in appendix 1 (section 3.3).

Mortality rates from dementia and Parkinson's disease reported in VR systems cannot be reconciled with observed trends in prevalence and excess mortality—a disparity that can be attributed to variation in death certification practices for these causes across countries and over time.¹⁷ For GBD 2017, we sought to address this known bias by using details from multiple cause of death data. For GBD 2017, multiple cause of death data were available to investigators only for the USA, where recent years show improved use of previously underutilised codes such as dementia. Statistical models of these USA data were used to reclassify deaths from other GBD causes and garbage codes to dementia and Parkinson's disease according to the pattern of intermediate and immediate causes observed in the most recent years. Model results were applied to all countries. A similar reallocation process was used for atrial fibrillation deaths misclassified as deaths due to heart failure or thromboembolic events. A detailed

For the Global Health Data Exchange see <http://ghdx.healthdata.org/>

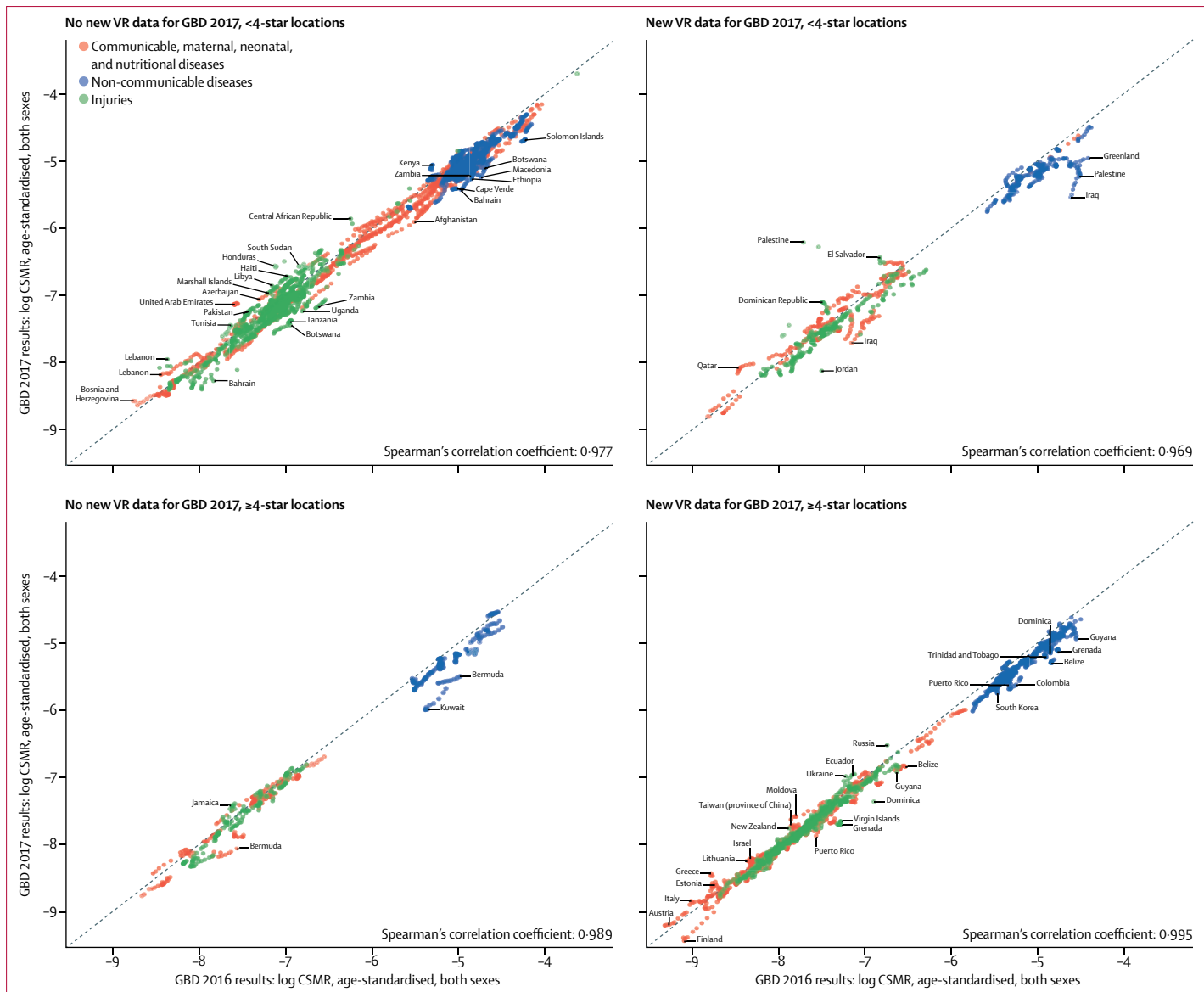


Figure 1: Effect of new VR data on Level 1 cause estimates from GBD 2016 to GBD 2017, based on national locations with varying quality of VR data, 2008–16
 The figure shows the degree of consistency between GBD 2016 and GBD 2017 estimates for Level 1 causes at the national level from 2008 to 2016. The diagonal line represents no change from GBD 2016 to GBD 2017. Each point represents one country-year, with colours indicating the Level 1 cause grouping (communicable, maternal, neonatal, and nutritional diseases; non-communicable diseases; and injuries). Panels indicate whether or not any new VR data between 2008 and 2016 were added for that location for GBD 2017, and whether or not a location has 4-star or 5-star VR quality. Points that are outside of the standard 95% prediction interval for a linear regression of 2017 values on 2016 values are annotated (if the same location-cause had multiple points in a time series, only the furthest-most point was annotated). The Spearman's correlation coefficient is noted in the lower right-hand corner of each panel. CSMR=cause-specific mortality rate. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. VR=vital registration.

description of these redistribution procedures and the manner in which they were applied to all countries is available in section 2 of appendix 1. This reallocation is illustrated in appendix 1 (section 7).

For the first time in GBD 2017, we separately estimated deaths from diabetes by type. Deaths due to diabetes can be reported in VR and VA data as type 1, type 2, or unspecified. Two data manipulation steps were necessary. First, we assumed all deaths reported in individuals

younger than 15 years were type 1 regardless of the original code assignment. Second, we redistributed unspecified diabetes deaths on the basis of a regression in which the true proportions of type 1 and type 2 deaths by age-sex-location-year are a function of the proportion of unspecified deaths, age, the age-standardised prevalence of obesity, and an interaction term for age and obesity prevalence. These methods are described in detail in appendix 1 (section 3.3).

Data completeness assessment

Completeness of VR data was assessed by location-year, and sources with less than 50% completeness were excluded. We multiplied the estimated all-cause mortality for each age-sex-location-year by the cause fraction for the corresponding age-sex-location-year to adjust all included sources to 100% completeness. VA and VR data availability and completeness are shown for each location-year in appendix 1 (section 7). To further characterise the quality of data available in each country, the GBD study rated each location-year from 1980 to 2017 on a level of 0 to 5 stars according to methods previously described.¹⁸ Ratings convey an overall measure of the reliability of cause of death estimates for each location-year but do not directly affect the estimation process.

Cause of death estimation with CODEm

The GBD Cause of Death Ensemble model (CODEm) systematically tested and combined results from different statistical models according to their out-of-sample predictive validity. Results are incorporated into a weighted ensemble model as detailed in appendix 1 (section 3.1) and below. For GBD 2017, CODEm was used to estimate 192 causes of death (appendix 1 section 7). To predict the level for each cause of death, we used CODEm to systematically test a large number of functional forms and permutations of covariates.¹⁸ Each resulting model that met the predetermined requirements for regression coefficient significance and direction was fit on 70% of the data, holding out 30% for cross-validation (appendix 1 section 3.1). Out-of-sample predictive validity of these models was assessed by use of repeated cross-validation tests on the first 15% of the held-out data. Various ensemble models with different weighting parameters were created from the combination of these models, with the highest weights assigned to models with the best out-of-sample prediction error for trends and levels, as detailed in appendix 1 (section 7). Model performance of these ensembles was assessed against the root-mean squared error (RMSE) of the ensemble model predictions of the log of the age-specific death rates for a cause, assessed with the same 15% of the data. The ensemble model performing best was subsequently selected and assessed against the other 15% of the data withheld from the statistical model building. CODEm was run independently by sex for each cause of death. A separate model was run for countries with 4-star or greater VR systems to avert uncertainty inflation from more heterogeneous data. The distribution of RMSE relative to cause-specific mortality rates (CSMRs) at Level 2 of the GBD hierarchy shows that model performance was weakest for causes of death with comparatively low mortality rates (figure 2; appendix 2), while models for more common causes of death such as stroke, chronic obstructive pulmonary disease, and self-harm and interpersonal violence generally had low RMSE.

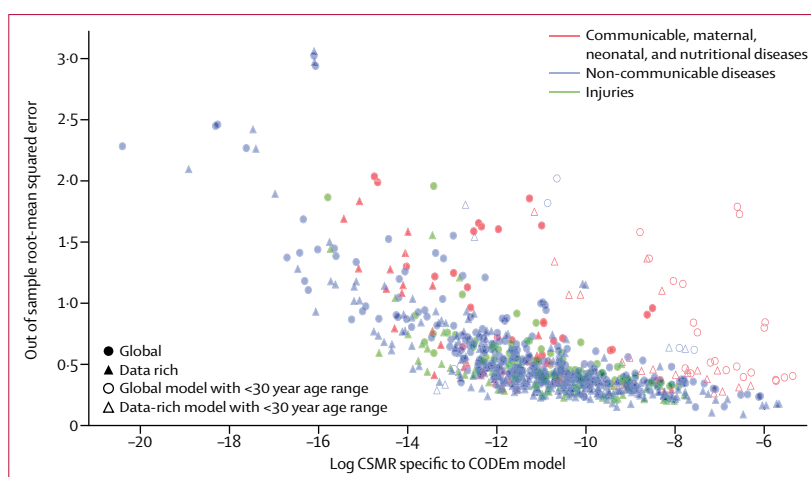


Figure 2: Out-of-sample model performance for CODEm models and age-standardised cause-specific mortality rate by Level 1 causes

Model performance was defined by the root-mean squared error of the ensemble model predictions of the log of the age-specific death rates for a cause with 15% of the data held out from the statistical model building. The figure shows the association between the root-mean squared error and the log of the CSMR, aggregated over 1980–2017. Each point represents one CODEm model specific for model-specific age ranges and sex. Circles denote models run with all locations. Triangles denote models run on only data-rich locations. Colours denote the Level 1 cause categories. Open circles and triangles denote models that were run with restricted age groups of less than 30 years. CODEm=Cause of Death Ensemble model. CSMR=cause-specific mortality rate.

Cause of death estimation with alternative estimation strategies

Alternative estimation strategies were used to model a subset of causes of death with unique epidemiology, large changes in reporting over time, or particularly limited data availability, including HIV/AIDS, malaria, chronic kidney disease, cirrhosis, liver cancer, meningitis, dementia, and atrial fibrillation. Alternative strategies included prevalence-based models, incidence and case fatality models, and sub-cause proportion models as described in appendix 1 (section 7). Mortality-incidence ratio models based on registry data were used to estimate mortality from 32 cancers (appendix 1 section 3.3). Negative-binomial models were used for eight causes of death with typically low death counts or causes that typically have no deaths in countries with a high Socio-demographic Index (SDI), including ascariasis, cystic echinococcosis, cysticercosis, diphtheria, iodine deficiency, other intestinal infectious diseases, schistosomiasis, and varicella and herpes zoster virus. Once underlying cause of death estimates and accompanying uncertainty were generated, these models were combined with the cause of death correction procedure (CoDCorrect) to establish estimates consistent with all-cause mortality levels for each age-sex-year location.

Estimation of fatal discontinuities

Fatal discontinuities are large changes in deaths due to unexpected spikes in injuries or epidemics—defined by GBD as more than one per million or more than

25 deaths—in a specific location-year. We classified fatal discontinuities as conflict and terrorism, major transportation accidents, natural disasters, other forms of disaster such as large fires or the collapse of large buildings, or major outbreaks of infectious diseases. Data on fatal discontinuities came from VR data in the 75 countries with a 4-star or 5-star data quality rating for the interval of 1980–2017. For the remaining 120 countries with a rating of 3 stars or lower, we used alternative databases (appendix 1 section 7). Cholera and meningitis were estimated as fatal discontinuities to reduce the risk of underestimation for small-magnitude outbreaks caused by the smoothing of VR or VA data over time in CODEm. To address lags in reporting and publishing of data, we included news reports and other supplemental data sources when known gaps existed. Further detail about fatal discontinuity estimation is presented in appendix 1 (section 3.3).

Pathogen counterfactual analysis

Aetiology-specific mortality was estimated for LRIs and diarrhoeal diseases by use of a counterfactual approach that relates the frequency of each aetiology in a population and the association with that aetiology and either LRI or diarrhoea. LRI and diarrhoea were selected as initial candidates for this counterfactual analysis approach given the large disease burden they represent and the broad interest in interventions, mostly vaccine-based, to reduce their burden.¹⁹ We attributed LRI deaths to four aetiologies: *Haemophilus influenzae* type B pneumonia, *Streptococcus pneumoniae* pneumococcal pneumonia, influenza, and respiratory syncytial virus pneumonia. Diarrhoeal deaths were attributed to 13 aetiologies: adenovirus, *Aeromonas* spp, *Campylobacter* spp, *Clostridium difficile*, cryptosporidiosis (*Cryptosporidium* spp), amoebiasis (*Entamoeba histolytica*), typical enteropathogenic *Escherichia coli*, enterotoxigenic *E coli*, norovirus, rotavirus, nontyphoidal *Salmonella* spp, shigellosis (*Shigella* spp), and cholera (*Vibrio cholerae*). The mortality attributable to each aetiology is the product of the attributable fraction and the mortality due to LRI or diarrhoea. The current counterfactual analysis is an extension of work begun in GBD 2010, based on the most common pathogens and available data. This method allows for less common aetiologies to be added in the future.

YLL computation

Years of life lost (YLLs) are a measure of premature death calculated as the sum of each death multiplied by the standard life expectancy at each age. The standard life expectancy was taken from the lowest observed risk of death for each five-year age group in all populations greater than 5 million. In 2017, GBD 2017 included a new demographic assessment of population, fertility, migration, and all-cause mortality.¹⁴ We used these components to generate single calendar-year and single

age-year estimates of the population using transparent and replicable methods.¹⁴ This independent assessment of the population was subsequently used in the calculation of YLL rates and age-standardised mortality rates. Details of these calculations are available in appendix 1 (section 4.3).

Decomposition of change in global deaths

Using methods adapted from demographic research from Das Gupta,²⁰ we decomposed change in numbers of deaths by cause from 2007 to 2017, using three explanatory components: as change occurring from growth in the total population; as shifts in population structure by age; or as changes in cause-specific mortality rates. We calculated the fraction of change in deaths by cause from each component using counterfactual scenarios, changing the level of one factor from 2007 to 2017, with all other factors held constant. Since the effect depends on the order of entry of the factor, we calculated the average of all combinations of the three factors. Thus, the change in global deaths due to shifts in population age structure could be calculated by comparing the number of deaths in 2007 to the number of deaths in 2017, using the population age structure from 2017 and holding both population size and cause-specific mortality rates at 2007 levels (appendix 1 section 7).

Uncertainty analysis

Uncertainty in our estimates was attributable to cause-specific model specifications; varied availability of data by age, sex, location, or year; and variability of sample size within data sources. We quantified and propagated uncertainty into final estimates by calculating uncertainty intervals (UIs) for cause-specific estimation components based on 1000 draws from the posterior distribution of cause-specific mortality by age, sex, location, and year.²¹ 95% UIs were calculated with the 2.5th and 97.5th percentiles, and point estimates were calculated from the mean of the draws. Changes over time were considered statistically significant when the uncertainty interval of the percentage change over time did not cross zero.

Socio-demographic Index and epidemiological transition analysis

The SDI is a value between 0.0 and 1.0 calculated from the geometric mean of three rescaled components: total fertility rate under 25 years (TFRU25), lag-distributed income per capita (LDI), and average educational attainment in the population older than 15 years.²² Because the total fertility rate—used in the calculation of SDI for GBD 2016—has a U-shaped association at the highest levels of development, for GBD 2017 we recomputed the SDI using TFRU25 only, an age range for which the association with development is clearest.¹⁴ We used a generalised additive model with a Loess smoother on SDI to estimate the association between SDI and each

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|--|---|------------------------------------|---|------------------------------------|--|------------------------------------|---|------------------------------------|
| | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 |
| All causes | 55 945.7 (55 356.4 to 56 516.7) | 9.3% (8.2 to 10.2)* | 737.7 (729.9 to 745.4) | -14.2% (-15.0 to -13.5)* | 1 646 249.6 (1 622 870.6 to 1 673 178.4) | -9.0% (-10.1 to -7.6)* | 21 926.4 (21 601.1 to 22 314.9) | -22.2% (-23.2 to -21.0)* |
| Communicable, maternal, neonatal, and nutritional diseases | 10 389.9 (10 004.0 to 10 975.9) | -22.2% (-24.0 to -20.0)* | 143.8 (138.4 to 151.6) | -31.8% (-33.3 to -30.1)* | 578 416.6 (558 815.0 to 600 759.1) | -30.4% (-32.4 to -28.2)* | 8280.6 (8005.4 to 8602.8) | -35.4% (-37.3 to -33.4)* |
| HIV/AIDS and sexually transmitted infections | 1073.6 (983.3 to 1182.4) | -47.7% (-50.0 to -45.1)* | 13.9 (12.6 to 15.5) | -53.6% (-55.8 to -51.0)* | 60 550.2 (53 533.7 to 69 156.3) | -47.3% (-50.2 to -44.0)* | 806.4 (703.1 to 936.7) | -52.1% (-55.2 to -48.6)* |
| HIV/AIDS | 954.5 (907.3 to 1009.7) | -50.3% (-52.1 to -48.3)* | 12.1 (11.5 to 12.9) | -56.5% (-58.0 to -54.7)* | 50 497.1 (47 658.0 to 53 595.8) | -51.2% (-52.9 to -49.2)* | 655.1 (617.5 to 696.4) | -56.6% (-58.1 to -54.8)* |
| HIV/AIDS and drug-susceptible tuberculosis co-infection | 194.6 (137.7 to 253.0) | -55.4% (-58.4 to -51.6)* | 2.5 (1.8 to 3.2) | -61.1% (-63.7 to -57.7)* | 10 664.8 (7613.4 to 13757.1) | -55.6% (-58.7 to -51.7)* | 140.0 (100.2 to 180.0) | -60.5% (-63.1 to -57.0)* |
| HIV/AIDS and multidrug-resistant tuberculosis without extensive drug resistance co-infection | 22.6 (13.4 to 34.5) | -52.2% (-66.4 to -33.2)* | 0.3 (0.2 to 0.4) | -58.1% (-70.5 to -41.5)* | 1247.8 (746.6 to 1906.7) | -51.7% (-65.7 to -33.2)* | 16.4 (9.8 to 25.1) | -56.8% (-69.3 to -40.4)* |
| HIV/AIDS and extensively drug-resistant tuberculosis co-infection | 1.2 (0.8 to 1.8) | -8.3% (-26.8 to 14.7) | 0.0 (0.0 to 0.0) | -20.3% (-36.4 to -0.2)* | 62.7 (38.3 to 92.9) | -10.5% (-28.4 to 11.5) | 0.8 (0.5 to 1.2) | -21.0% (-36.7 to -1.4)* |
| HIV/AIDS resulting in other diseases | 736.0 (659.5 to 817.7) | -48.7% (-51.1 to -45.9)* | 9.3 (8.4 to 10.4) | -55.1% (-57.2 to -52.6)* | 38 521.8 (34 381.3 to 43 095.5) | -49.8% (-52.3 to -46.9)* | 497.9 (444.2 to 558.4) | -55.4% (-57.6 to -52.8)* |
| Sexually transmitted infections excluding HIV | 119.1 (50.8 to 220.4) | -10.8% (-18.4 to -2.5)* | 1.8 (0.7 to 3.3) | -14.4% (-21.5 to -6.6)* | 10 053.1 (4057.0 to 18 915.2) | -11.4% (-19.0 to -3.2)* | 151.3 (60.6 to 285.3) | -14.4% (-21.8 to -6.6)* |
| Syphilis | 113.5 (45.2 to 214.5) | -11.3% (-19.1 to -2.8)* | 1.7 (0.7 to 3.2) | -14.3% (-21.8 to -6.4)* | 9836.1 (3848.5 to 18 676.4) | -11.5% (-19.3 to -3.1)* | 148.6 (58.0 to 282.3) | -14.3% (-21.8 to -6.2)* |
| Chlamydial infection | 1.1 (0.9 to 1.2) | 2.5% (-4.5 to 11.3) | 0.0 (0.0 to 0.0) | -15.2% (-21.0 to -8.4)* | 40.5 (32.6 to 45.0) | -5.5% (-12.2 to 2.5) | 0.5 (0.4 to 0.6) | -17.9% (-23.7 to -11.0)* |
| Gonococcal infection | 3.0 (2.4 to 3.3) | 3.7% (-3.4 to 12.5) | 0.0 (0.0 to 0.0) | -14.9% (-20.8 to -8.2)* | 112.8 (90.2 to 124.9) | -3.8% (-10.7 to 4.3) | 1.4 (1.1 to 1.6) | -17.4% (-23.5 to -10.7)* |
| Other sexually transmitted infections | 1.5 (1.2 to 1.7) | 0.2% (-6.4 to 8.3) | 0.0 (0.0 to 0.0) | -15.9% (-21.6 to -9.5)* | 63.6 (51.0 to 70.7) | -6.2% (-12.7 to 1.1) | 0.8 (0.6 to 0.9) | -18.2% (-23.9 to -11.7)* |
| Respiratory infections and tuberculosis | 3752.3 (3629.4 to 3889.3) | -8.0% (-10.3 to -5.5)* | 50.5 (48.8 to 52.3) | -24.5% (-26.4 to -22.6)* | 148 233.5 (141 335.1 to 155 291.4) | -24.7% (-27.4 to -21.7)* | 2056.0 (1956.3 to 2160.7) | -32.8% (-35.4 to -30.0)* |
| Tuberculosis | 1183.7 (1129.8 to 1245.3) | -14.9% (-18.2 to -10.3)* | 14.9 (14.3 to 15.7) | -31.4% (-34.1 to -27.6)* | 41 876.9 (39 972.4 to 44 120.5) | -21.2% (-24.4 to -17.4)* | 533.4 (509.1 to 562.6) | -33.3% (-35.9 to -30.0)* |
| Drug-susceptible tuberculosis | 1044.1 (951.6 to 1129.2) | -15.5% (-22.3 to -8.6)* | 13.2 (12.0 to 14.2) | -31.9% (-37.3 to -26.4)* | 36 932.5 (33 846.8 to 39 919.1) | -21.9% (-27.8 to -16.0)* | 470.7 (431.3 to 508.4) | -33.8% (-38.7 to -29.0)* |
| Multidrug-resistant tuberculosis without extensive drug resistance | 126.9 (70.1 to 202.2) | -11.6% (-47.4 to 38.1) | 1.6 (0.9 to 2.5) | -28.6% (-57.4 to 11.4) | 4505.1 (2582.5 to 6984.6) | -17.6% (-49.4 to 26.5) | 57.2 (33.0 to 88.4) | -30.2% (-56.9 to 6.6) |
| Extensively drug-resistant tuberculosis | 12.6 (8.6 to 18.0) | 14.0% (-18.7 to 58.7) | 0.2 (0.1 to 0.2) | -7.7% (-34.1 to 28.8) | 439.2 (306.2 to 616.5) | 5.5% (-23.2 to 44.9) | 5.5 (3.8 to 7.7) | -11.1% (-35.2 to 22.1) |
| Lower respiratory infections | 2558.6 (2442.2 to 2655.4) | -4.3% (-6.9 to -1.5)* | 35.4 (33.8 to 36.8) | -21.1% (-23.2 to -18.9)* | 105 834.5 (99 746.4 to 111 767.8) | -25.9% (-29.2 to -22.2)* | 1515.1 (1424.8 to 1602.2) | -32.6% (-35.7 to -29.2)* |
| Upper respiratory infections | 9.1 (6.1 to 12.4) | -30.5% (-41.0 to -14.5)* | 0.1 (0.1 to 0.2) | -42.1% (-49.6 to -29.9)* | 477.3 (247.3 to 730.5) | -33.2% (-44.1 to -12.9)* | 6.9 (3.5 to 10.6) | -38.6% (-48.3 to -19.4)* |
| Otitis media | 0.9 (0.7 to 1.5) | -41.4% (-51.6 to -28.4)* | 0.0 (0.0 to 0.0) | -50.4% (-58.8 to -39.9)* | 44.8 (31.2 to 72.1) | -49.4% (-59.9 to -35.5)* | 0.6 (0.4 to 1.0) | -54.5% (-64.1 to -41.8)* |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|--|-------------------------------------|------------------------------------|---|------------------------------------|--|------------------------------------|---|------------------------------------|
| | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 |
| (Continued from previous page) | | | | | | | | |
| Enteric infections | 1766.0 (1398.0 to 2386.0) | -17.2% (-24.6 to -8.2)* | 24.4 (19.5 to 32.4) | -29.9% (-34.9 to -23.1)* | 84 625.5 (73 770.6 to 100 720.2) | -30.6% (-36.3 to -23.7)* | 1208.6 (1064.1 to 1424.7) | -36.6% (-41.8 to -30.7)* |
| Diarrhoeal diseases | 1569.6 (1176.0 to 2193.0) | -16.6% (-25.3 to -6.7)* | 21.6 (16.4 to 29.7) | -30.2% (-36.1 to -22.7)* | 70 574.3 (60 421.1 to 86 165.2) | -32.0% (-38.6 to -23.9)* | 1009.1 (870.5 to 1211.0) | -38.1% (-43.9 to -31.3)* |
| Typhoid and paratyphoid | 135.9 (76.9 to 218.9) | -22.3% (-27.3 to -18.1)* | 1.9 (1.1 to 3.0) | -27.8% (-32.8 to -23.9)* | 9686.1 (5484.9 to 15 746.2) | -23.8% (-29.3 to -19.4)* | 136.3 (77.0 to 220.9) | -28.7% (-34.0 to -24.4)* |
| Typhoid fever | 116.8 (65.4 to 187.7) | -23.7% (-29.0 to -19.3)* | 1.6 (0.9 to 2.6) | -29.1% (-34.1 to -25.0)* | 8331.7 (4632.5 to 13 419.2) | -25.3% (-31.0 to -20.8)* | 117.3 (65.5 to 188.5) | -30.1% (-35.6 to -25.7)* |
| Paratyphoid fever | 19.1 (8.7 to 37.3) | -12.7% (-20.1 to -4.2)* | 0.3 (0.1 to 0.5) | -18.9% (-26.1 to -10.8)* | 1354.4 (622.3 to 2620.2) | -13.2% (-21.3 to -3.8)* | 19.0 (8.8 to 36.6) | -18.6% (-26.5 to -9.7)* |
| Invasive non-typhoidal salmonella | 59.1 (33.3 to 98.1) | -17.9% (-25.1 to -8.7)* | 0.8 (0.5 to 1.4) | -24.8% (-31.9 to -15.6)* | 4260.8 (2382.0 to 7378.6) | -17.2% (-25.7 to -6.8)* | 61.6 (34.7 to 107.6) | -22.6% (-30.7 to -12.5)* |
| Other intestinal infectious diseases | 1.4 (1.0 to 2.2) | -39.7% (-67.1 to 9.7) | 0.0 (0.0 to 0.0) | -44.7% (-70.1 to 2.3) | 104.4 (67.8 to 170.7) | -43.6% (-71.6 to 11.9) | 1.5 (1.0 to 2.5) | -46.9% (-73.7 to 6.3) |
| Neglected tropical diseases and malaria | 720.1 (530.7 to 938.8) | -29.0% (-37.3 to -19.3)* | 10.1 (7.5 to 13.2) | -36.1% (-43.7 to -27.3)* | 48 656.2 (35 574.6 to 64 934.2) | -33.7% (-42.4 to -23.7)* | 699.9 (508.0 to 933.6) | -38.6% (-46.7 to -29.2)* |
| Malaria | 619.8 (440.1 to 839.5) | -30.8% (-39.4 to -20.8)* | 8.7 (6.1 to 11.9) | -37.3% (-45.4 to -27.9)* | 43 546.6 (29 966.3 to 59 772.4) | -34.5% (-43.8 to -23.6)* | 629.4 (432.6 to 858.7) | -39.2% (-48.2 to -28.8)* |
| Chagas disease | 7.9 (7.5 to 8.6) | 3.8% (-1.6 to 12.9) | 0.1 (0.1 to 0.1) | -21.1% (-25.2 to -14.3)* | 174.9 (166.1 to 193.5) | -4.2% (-9.0 to 4.8) | 2.2 (2.0 to 2.4) | -25.1% (-28.9 to -18.1)* |
| Leishmaniasis | 7.5 (0.0 to 34.5) | -64.8% (-96.8 to -44.5)* | 0.1 (0.0 to 0.5) | -67.8% (-97.5 to -50.3)* | 509.8 (0.3 to 2440.2) | -63.8% (-92.1 to -39.7)* | 7.2 (0.0 to 34.6) | -66.2% (-93.2 to -43.8)* |
| Visceral leishmaniasis | 7.5 (0.0 to 34.5) | -64.8% (-96.8 to -44.5)* | 0.1 (0.0 to 0.5) | -67.8% (-97.5 to -50.3)* | 509.8 (0.3 to 2440.2) | -63.8% (-92.1 to -39.7)* | 7.2 (0.0 to 34.6) | -66.2% (-93.2 to -43.8)* |
| African trypanosomiasis | 1.4 (0.3 to 4.9) | -80.7% (-95.6 to -27.8)* | 0.0 (0.0 to 0.1) | -82.8% (-96.0 to -34.3)* | 77.6 (15.0 to 283.6) | -80.8% (-95.6 to -27.2)* | 1.0 (0.2 to 3.8) | -82.3% (-96.0 to -33.6)* |
| Schistosomiasis | 8.8 (8.0 to 9.8) | -12.3% (-17.6 to -6.4)* | 0.1 (0.1 to 0.1) | -28.5% (-32.7 to -23.7)* | 342.3 (305.3 to 384.3) | -15.6% (-21.9 to -8.8)* | 4.4 (3.9 to 5.0) | -27.4% (-32.9 to -21.4)* |
| Cysticercosis | 0.7 (0.5 to 1.0) | -15.9% (-42.7 to 23.3) | 0.0 (0.0 to 0.0) | -27.3% (-50.5 to 5.3) | 39.6 (26.9 to 55.0) | -20.5% (-46.9 to 18.2) | 0.5 (0.4 to 0.7) | -28.9% (-52.5 to 4.8) |
| Cystic echinococcosis | 1.2 (0.9 to 1.5) | -30.0% (-52.1 to -1.3)* | 0.0 (0.0 to 0.0) | -41.9% (-59.8 to -19.0)* | 52.0 (38.1 to 68.0) | -38.8% (-56.8 to -12.9)* | 0.7 (0.5 to 0.9) | -46.4% (-62.0 to -24.1)* |
| Dengue | 40.5 (17.6 to 49.8) | 65.5% (21.7 to 99.7)* | 0.5 (0.2 to 0.7) | 40.7% (3.6 to 69.7)* | 1902.9 (716.6 to 2312.9) | 32.0% (-1.8 to 61.2) | 26.1 (9.8 to 31.7) | 18.2% (-12.0 to 45.0) |
| Yellow fever | 4.8 (1.0 to 13.8) | -16.6% (-28.7 to -2.0)* | 0.1 (0.0 to 0.2) | -23.3% (-34.4 to -9.6)* | 313.9 (67.2 to 900.2) | -16.0% (-28.9 to 0.0) | 4.3 (0.9 to 12.4) | -21.3% (-33.6 to -5.8)* |
| Rabies | 11.7 (9.3 to 14.7) | -48.1% (-58.8 to -37.3)* | 0.2 (0.1 to 0.2) | -54.8% (-63.8 to -45.0)* | 633.7 (504.4 to 836.4) | -51.5% (-61.3 to -38.9)* | 8.6 (6.8 to 11.5) | -56.2% (-65.1 to -44.3)* |
| Intestinal nematode infections | 3.2 (2.5 to 4.1) | -43.1% (-56.1 to -25.0)* | 0.0 (0.0 to 0.1) | -47.2% (-59.5 to -30.1)* | 257.1 (194.1 to 336.3) | -44.1% (-57.6 to -25.0)* | 3.8 (2.9 to 5.0) | -47.6% (-60.4 to -29.6)* |
| Ascariasis | 3.2 (2.5 to 4.1) | -43.1% (-56.1 to -25.0)* | 0.0 (0.0 to 0.1) | -47.2% (-59.5 to -30.1)* | 257.1 (194.1 to 336.3) | -44.1% (-57.6 to -25.0)* | 3.8 (2.9 to 5.0) | -47.6% (-60.4 to -29.6)* |
| Ebola virus disease | 0.0 (0.0 to 0.0) | -98.2% (-98.4 to -98.0)* | 0.0 (0.0 to 0.0) | -98.4% (-98.6 to -98.2)* | 0.5 (0.5 to 0.5) | -98.1% (-98.3 to -97.9)* | 0.0 (0.0 to 0.0) | -98.2% (-98.4 to -98.0)* |
| Zika virus disease | 0.0 (0.0 to 0.1) | .. | 0.0 (0.0 to 0.0) | .. | 1.0 (0.2 to 3.4) | .. | 0.0 (0.0 to 0.0) | .. |
| Other neglected tropical diseases | 12.6 (8.0 to 36.3) | 8.1% (-8.1 to 28.2) | 0.2 (0.1 to 0.5) | -3.7% (-18.3 to 13.9) | 804.3 (442.8 to 2696.6) | 3.9% (-16.3 to 29.4) | 11.6 (6.3 to 39.6) | -3.5% (-22.2 to 20.7) |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|--|-------------------------------------|------------------------------------|---|------------------------------------|--|------------------------------------|---|------------------------------------|
| | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 |
| (Continued from previous page) | | | | | | | | |
| Other infectious diseases | 830.5 (732.2 to 947.8) | -25.9% (-32.4 to -18.8)* | 11.6 (10.1 to 13.3) | -33.8% (-39.3 to -27.4)* | 53 008.6 (44 786.0 to 63 000.4) | -33.0% (-39.6 to -25.1)* | 762.8 (640.5 to 911.5) | -37.9% (-44.0 to -30.5)* |
| Meningitis | 288.0 (254.3 to 333.2) | -20.1% (-26.0 to -11.0)* | 4.0 (3.6 to 4.6) | -27.8% (-33.1 to -19.3)* | 19 436.9 (16 935.1 to 22 335.8) | -25.2% (-31.5 to -15.7)* | 280.5 (243.6 to 323.2) | -30.2% (-36.3 to -21.4)* |
| Pneumococcal meningitis | 42.1 (36.6 to 49.4) | -13.4% (-20.6 to -2.3)* | 0.6 (0.5 to 0.7) | -22.4% (-28.9 to -12.4)* | 2751.8 (2325.8 to 3276.5) | -18.5% (-26.8 to -6.5)* | 39.6 (33.4 to 47.0) | -24.2% (-32.1 to -12.8)* |
| <i>H influenzae</i> type B meningitis | 75.7 (66.7 to 92.0) | -33.7% (-39.6 to -26.0)* | 1.1 (0.9 to 1.3) | -40.6% (-45.8 to -33.9)* | 4907.3 (4232.2 to 5813.6) | -40.4% (-46.1 to -33.0)* | 70.5 (60.6 to 83.9) | -44.7% (-50.1 to -37.7)* |
| Meningococcal infection | 30.0 (25.7 to 35.7) | -31.5% (-37.4 to -22.8)* | 0.4 (0.4 to 0.5) | -37.1% (-42.6 to -29.2)* | 2180.3 (1819.8 to 2614.5) | -34.9% (-41.4 to -26.4)* | 31.9 (26.5 to 38.4) | -38.8% (-45.0 to -30.5)* |
| Other meningitis | 140.3 (121.4 to 161.8) | -8.9% (-15.4 to 1.4) | 2.0 (1.7 to 2.3) | -17.3% (-23.4 to -7.5)* | 9597.5 (8195.6 to 11 118.5) | -12.8% (-20.4 to -0.7)* | 138.5 (118.3 to 160.5) | -18.4% (-25.7 to -7.4)* |
| Encephalitis | 92.4 (83.1 to 107.9) | 0.0% (-14.2 to 16.2) | 1.2 (1.1 to 1.4) | -14.3% (-26.5 to -0.9)* | 4588.2 (4059.5 to 5230.7) | -12.1% (-28.1 to 4.5) | 64.1 (56.6 to 72.4) | -20.1% (-35.0 to -5.0)* |
| Diphtheria | 3.6 (2.2 to 6.1) | -23.9% (-55.6 to 36.4) | 0.1 (0.0 to 0.1) | -28.6% (-58.8 to 29.2) | 298.7 (181.8 to 510.0) | -23.9% (-56.7 to 38.7) | 4.4 (2.7 to 7.6) | -28.3% (-59.5 to 31.4) |
| Whooping cough | 91.8 (45.9 to 163.2) | -23.3% (-54.8 to 35.6) | 1.4 (0.7 to 2.4) | -27.1% (-57.1 to 28.8) | 7879.2 (3938.1 to 14 010.3) | -23.3% (-54.8 to 35.4) | 117.9 (58.9 to 209.6) | -27.1% (-57.0 to 28.8) |
| Tetanus | 38.1 (25.9 to 48.8) | -54.9% (-65.9 to -39.1)* | 0.5 (0.4 to 0.7) | -59.6% (-69.3 to -45.0)* | 2447.7 (1734.9 to 3199.0) | -59.3% (-69.9 to -43.5)* | 35.1 (25.0 to 46.3) | -62.1% (-72.1 to -47.0)* |
| Measles | 95.3 (34.5 to 205.2) | -57.0% (-61.9 to -51.9)* | 1.4 (0.5 to 3.1) | -59.3% (-64.0 to -54.4)* | 8105.1 (2935.7 to 17 469.0) | -56.9% (-61.8 to -51.8)* | 120.8 (43.7 to 260.4) | -59.2% (-63.9 to -54.3)* |
| Varicella and herpes zoster | 15.6 (14.4 to 17.3) | -16.4% (-22.9 to -9.5)* | 0.2 (0.2 to 0.2) | -29.2% (-34.7 to -23.4)* | 833.0 (742.3 to 938.1) | -22.5% (-31.4 to -13.2)* | 12.1 (10.7 to 13.6) | -28.4% (-36.6 to -19.4)* |
| Acute hepatitis | 126.4 (94.5 to 143.7) | -9.8% (-15.5 to -2.3)* | 1.6 (1.2 to 1.9) | -24.5% (-29.2 to -18.4)* | 5478.4 (4040.3 to 6330.0) | -21.7% (-27.7 to -14.4)* | 72.3 (52.9 to 83.9) | -31.2% (-36.5 to -24.9)* |
| Acute hepatitis A | 18.6 (13.6 to 23.8) | -33.1% (-41.9 to -22.5)* | 0.3 (0.2 to 0.3) | -38.7% (-46.8 to -28.6)* | 1286.7 (935.2 to 1633.7) | -36.0% (-45.1 to -24.3)* | 18.0 (13.0 to 22.9) | -40.7% (-49.1 to -29.0)* |
| Acute hepatitis B | 89.6 (66.1 to 102.5) | -0.8% (-8.4 to 8.5) | 1.1 (0.8 to 1.3) | -19.6% (-25.4 to -12.4)* | 3262.4 (2367.8 to 3819.1) | -12.2% (-19.7 to -2.7)* | 41.8 (30.1 to 49.3) | -25.6% (-31.9 to -17.5)* |
| Acute hepatitis C | 3.5 (1.9 to 6.0) | -23.7% (-35.9 to -9.4)* | 0.0 (0.0 to 0.1) | -32.1% (-42.4 to -19.6)* | 219.7 (120.1 to 371.3) | -31.0% (-43.3 to -15.3)* | 3.2 (1.8 to 5.4) | -35.5% (-47.2 to -20.7)* |
| Acute hepatitis E | 14.7 (10.4 to 18.5) | -15.8% (-27.2 to -3.1)* | 0.2 (0.1 to 0.2) | -25.8% (-35.3 to -15.6)* | 709.6 (489.6 to 903.9) | -25.5% (-35.2 to -14.5)* | 9.3 (6.4 to 11.8) | -31.9% (-40.6 to -22.0)* |
| Other unspecified infectious diseases | 79.3 (59.9 to 85.1) | 1.6% (-3.1 to 7.9) | 1.1 (0.8 to 1.2) | -13.4% (-17.5 to -8.1)* | 3941.3 (2831.7 to 4325.8) | -10.2% (-16.2 to -2.4)* | 55.6 (39.6 to 61.3) | -17.9% (-23.6 to -10.6)* |
| Maternal and neonatal disorders | 1977.4 (1890.1 to 2060.6) | -24.1% (-26.9 to -21.0)* | 29.5 (28.2 to 30.8) | -26.6% (-29.3 to -23.5)* | 167 684.6 (160 060.7 to 174 918.2) | -24.2% (-27.1 to -20.9)* | 2518.2 (2403.8 to 2627.1) | -26.5% (-29.3 to -23.3)* |
| Maternal disorders | 193.6 (179.9 to 209.6) | -24.0% (-28.4 to -19.5)* | 2.5 (2.3 to 2.7) | -30.7% (-34.8 to -26.6)* | 10 993.1 (10 198.9 to 11 928.5) | -25.3% (-29.7 to -20.9)* | 140.9 (130.8 to 153.0) | -31.5% (-35.5 to -27.5)* |
| Maternal haemorrhage | 38.5 (33.2 to 45.2) | -52.1% (-59.0 to -44.2)* | 0.5 (0.4 to 0.6) | -56.4% (-62.7 to -49.3)* | 2173.8 (1859.7 to 2552.5) | -53.0% (-60.1 to -45.0)* | 27.8 (23.8 to 32.7) | -57.1% (-63.6 to -49.7)* |
| Maternal sepsis and other pregnancy-related infections | 21.2 (18.2 to 25.0) | -27.1% (-38.8 to -15.1)* | 0.3 (0.2 to 0.3) | -33.5% (-44.2 to -22.6)* | 1198.0 (1022.8 to 1420.8) | -28.9% (-41.1 to -16.2)* | 15.4 (13.1 to 18.3) | -34.5% (-45.4 to -22.5)* |
| Maternal hypertensive disorders | 29.4 (25.4 to 34.5) | -5.5% (-20.7 to 11.2) | 0.4 (0.3 to 0.4) | -13.0% (-27.3 to 2.6) | 1729.6 (1487.6 to 2033.2) | -6.6% (-22.1 to 10.2) | 22.3 (19.2 to 26.4) | -13.6% (-28.1 to 2.0) |
| Maternal obstructed labour and uterine rupture | 13.0 (10.2 to 16.8) | -17.7% (-35.9 to 2.9) | 0.2 (0.1 to 0.2) | -25.2% (-41.0 to -6.3)* | 720.9 (565.5 to 946.4) | -18.9% (-37.6 to 1.9) | 9.2 (7.2 to 12.1) | -25.8% (-42.9 to -6.9)* |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|--|--|---|---|---|---|---|--|---|
| | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 |
| (Continued from previous page) | | | | | | | | |
| Maternal abortive outcome | 17.4 (14.7 to 20.8) | -7.0% (-22.3 to 10.1) | 0.2 (0.2 to 0.3) | -15.7% (-29.3 to -0.4)* | 963.4 (807.6 to 1161.1) | -8.9% (-24.2 to 8.7) | 12.3 (10.3 to 14.9) | -16.8% (-30.7 to -0.5)* |
| Ectopic pregnancy | 10.2 (7.1 to 15.2) | -11.6% (-41.4 to 27.9) | 0.1 (0.1 to 0.2) | -19.2% (-46.2 to 16.8) | 590.6 (409.0 to 881.4) | -13.3% (-43.8 to 26.9) | 7.6 (5.3 to 11.4) | -20.3% (-48.1 to 17.0) |
| Indirect maternal deaths | 34.1 (30.0 to 38.7) | -4.1% (-16.7 to 8.5) | 0.4 (0.4 to 0.5) | -12.5% (-24.0 to -1.0)* | 1934.4 (1694.2 to 2216.7) | -6.1% (-19.2 to 6.8) | 24.8 (21.7 to 28.5) | -13.9% (-25.8 to -2.3)* |
| Late maternal deaths | 3.4 (2.6 to 4.3) | -0.9% (-7.0 to 5.5) | 0.0 (0.0 to 0.1) | -9.5% (-14.7 to -4.0)* | 194.7 (152.2 to 251.4) | -2.0% (-8.2 to 4.1) | 2.5 (2.0 to 3.2) | -10.1% (-15.4 to -4.5)* |
| Maternal deaths aggravated by HIV/AIDS | 1.6 (1.0 to 2.1) | -23.9% (-31.0 to -16.0)* | 0.0 (0.0 to 0.0) | -32.1% (-38.4 to -25.2)* | 84.4 (53.0 to 113.8) | -26.7% (-33.6 to -19.2)* | 1.1 (0.7 to 1.4) | -34.2% (-40.6 to -27.5)* |
| Other maternal disorders | 24.8 (20.8 to 29.8) | -8.5% (-24.7 to 11.2) | 0.3 (0.3 to 0.4) | -16.5% (-31.2 to 1.5) | 1403.1 (1159.5 to 1690.3) | -9.8% (-26.7 to 10.8) | 18.0 (14.9 to 21.7) | -17.2% (-32.9 to 1.2) |
| Neonatal disorders | 1783.8 (1698.5 to 1864.7) | -24.1% (-27.2 to -20.6)* | 27.1 (25.8 to 28.3) | -26.2% (-29.1 to -22.7)* | 156 691.6 (149 207.2 to 163 802.2) | -24.1% (-27.2 to -20.6)* | 2377.2 (2263.7 to 2485.1) | -26.2% (-29.1 to -22.7)* |
| Neonatal preterm birth | 649.4 (605.4 to 721.3) | -26.2% (-31.3 to -21.5)* | 9.9 (9.2 to 10.9) | -28.1% (-33.2 to -23.6)* | 57 052.0 (53 182.3 to 63 367.1) | -26.2% (-31.3 to -21.5)* | 865.6 (806.9 to 961.5) | -28.1% (-33.2 to -23.6)* |
| Neonatal encephalopathy due to birth asphyxia and trauma | 533.3 (476.9 to 580.3) | -24.5% (-30.2 to -18.0)* | 8.1 (7.2 to 8.8) | -26.5% (-32.0 to -20.2)* | 46 845.9 (41 894.4 to 50 985.7) | -24.5% (-30.2 to -18.0)* | 710.8 (635.7 to 773.7) | -26.5% (-32.0 to -20.2)* |
| Neonatal sepsis and other neonatal infections | 203.0 (178.7 to 267.1) | -11.9% (-20.5 to -1.7)* | 3.1 (2.7 to 4.1) | -14.4% (-22.7 to -4.4)* | 17 830.7 (15 692.9 to 23 459.0) | -11.9% (-20.5 to -1.7)* | 270.4 (238.0 to 355.8) | -14.4% (-22.7 to -4.4)* |
| Haemolytic disease and other neonatal jaundice | 49.1 (42.9 to 55.9) | -37.5% (-45.3 to -28.2)* | 0.7 (0.7 to 0.8) | -39.3% (-46.8 to -30.2)* | 4309.1 (3771.2 to 4914.0) | -37.5% (-45.3 to -28.2)* | 65.4 (57.2 to 74.5) | -39.3% (-46.8 to -30.2)* |
| Other neonatal disorders | 349.0 (294.9 to 382.3) | -23.6% (-29.8 to -15.5)* | 5.3 (4.5 to 5.8) | -25.7% (-31.7 to -17.8)* | 30 654.0 (25 899.7 to 33 578.7) | -23.6% (-29.8 to -15.5)* | 465.0 (392.9 to 509.4) | -25.7% (-31.7 to -17.8)* |
| Nutritional deficiencies | 270.0 (249.3 to 295.5) | -23.9% (-29.2 to -15.7)* | 3.8 (3.5 to 4.2) | -33.6% (-38.1 to -26.5)* | 15 658.0 (14 051.5 to 17 506.6) | -34.7% (-40.5 to -26.1)* | 228.7 (204.9 to 255.9) | -39.4% (-44.8 to -31.4)* |
| Protein-energy malnutrition | 231.8 (212.4 to 254.2) | -26.1% (-31.7 to -17.9)* | 3.3 (3.0 to 3.7) | -34.6% (-39.4 to -27.5)* | 14 405.4 (12 873.5 to 16 128.0) | -35.1% (-41.1 to -26.7)* | 211.8 (189.0 to 237.3) | -39.4% (-45.0 to -31.6)* |
| Other nutritional deficiencies | 38.2 (33.7 to 44.6) | -7.2% (-14.6 to 3.1) | 0.5 (0.4 to 0.6) | -25.8% (-31.7 to -17.5)* | 1252.7 (1087.5 to 1435.2) | -29.2% (-36.9 to -19.7)* | 16.9 (14.6 to 19.5) | -38.6% (-45.4 to -30.4)* |
| Non-communicable diseases | 41 071.1 (40 470.9 to 41 548.9) | 22.7% (21.5 to 23.9)* | 536.1 (528.4 to 542.2) | -7.9% (-8.8 to -7.0)* | 872 601.8 (859 538.6 to 884 787.7) | 13.6% (12.2 to 14.9)* | 11 097.4 (10 928.6 to 11 253.8) | -9.6% (-10.7 to -8.6)* |
| Neoplasms | 9556.2 (9395.7 to 9692.3) | 25.4% (23.9 to 27.0)* | 121.2 (119.1 to 122.9) | -4.4% (-5.6 to -3.3)* | 225 738.1 (221 608.8 to 229 322.4) | 19.6% (17.8 to 21.4)* | 2803.4 (2751.5 to 2848.8) | -5.6% (-7.0 to -4.1)* |
| Lip and oral cavity cancer | 193.7 (184.7 to 201.6) | 35.6% (29.5 to 40.8)* | 2.4 (2.3 to 2.5) | 4.0% (-0.6 to 8.0) | 5090.6 (4819.5 to 5328.3) | 30.5% (23.8 to 36.4)* | 62.2 (58.9 to 65.1) | 3.0% (-2.3 to 7.6) |
| Nasopharynx cancer | 69.5 (66.9 to 72.3) | 24.4% (20.0 to 28.8)* | 0.9 (0.8 to 0.9) | -3.0% (-6.4 to 0.4) | 2034.5 (1954.7 to 2117.4) | 18.3% (13.9 to 23.1)* | 24.8 (23.8 to 25.8) | -5.0% (-8.5 to -1.3)* |
| Other pharynx cancer | 117.4 (102.1 to 124.5) | 40.4% (29.7 to 48.4)* | 1.4 (1.3 to 1.5) | 7.9% (-0.3 to 14.0) | 3204.2 (2766.3 to 3405.1) | 36.0% (25.4 to 44.2)* | 38.9 (33.5 to 41.3) | 6.5% (-1.7 to 12.8) |
| Oesophageal cancer | 436.0 (425.0 to 447.6) | 13.0% (9.9 to 16.3)* | 5.5 (5.3 to 5.6) | -14.5% (-16.9 to -12.0)* | 9647.5 (9410.7 to 9903.5) | 8.9% (5.8 to 12.2)* | 118.3 (115.4 to 121.4) | -16.2% (-18.6 to -13.7)* |
| Stomach cancer | 865.0 (848.3 to 884.7) | 9.4% (7.1 to 12.1)* | 11.0 (10.8 to 11.2) | -17.1% (-18.8 to -15.1)* | 18 782.0 (18 409.7 to 19 207.7) | 4.8% (2.4 to 7.4)* | 231.6 (227.0 to 236.8) | -18.6% (-20.5 to -16.6)* |
| Colon and rectum cancer | 896.0 (876.3 to 915.7) | 27.8% (24.0 to 31.3)* | 11.5 (11.3 to 11.8) | -4.3% (-7.1 to -1.8)* | 18 106.7 (17 678.0 to 18 525.0) | 23.8% (19.2 to 27.6)* | 224.7 (219.4 to 229.9) | -4.5% (-8.0 to -1.7)* |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|--|------------------------------|----------------------------|---|-----------------------------|------------------------------------|----------------------------|---|-----------------------------|
| | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 |
| (Continued from previous page) | | | | | | | | |
| Liver cancer | 819.4 (789.7 to 855.5) | 27.0% (23.0 to 32.9)* | 10.2 (9.8 to 10.7) | -2.5% (-5.6 to 2.0) | 20 536.2 (19 678.7 to 21 551.9) | 21.2% (17.0 to 27.4)* | 250.7 (240.4 to 263.0) | -4.6% (-8.0 to 0.1) |
| Liver cancer due to hepatitis B | 325.4 (304.6 to 348.2) | 20.3% (15.3 to 28.2)* | 4.0 (3.7 to 4.3) | -6.2% (-10.0 to 0.1) | 9449.0 (8837.3 to 10 138.6) | 14.7% (9.7 to 21.9)* | 114.6 (107.3 to 123.0) | -8.4% (-12.2 to -2.6)* |
| Liver cancer due to hepatitis C | 234.3 (219.4 to 250.6) | 30.4% (26.7 to 35.0)* | 3.0 (2.8 to 3.2) | -2.1% (-4.9 to 1.4) | 4898.4 (4554.0 to 5259.3) | 26.9% (23.3 to 31.6)* | 60.3 (56.2 to 64.7) | -3.0% (-5.8 to 0.5) |
| Liver cancer due to alcohol use | 129.3 (114.5 to 147.3) | 31.7% (26.8 to 37.3)* | 1.6 (1.4 to 1.8) | 0.6% (-3.0 to 4.8) | 3040.7 (2647.6 to 3549.8) | 27.8% (22.4 to 33.9)* | 37.2 (32.5 to 43.3) | -0.6% (-4.5 to 3.9) |
| Liver cancer due to NASH | 66.9 (59.6 to 74.5) | 42.3% (38.0 to 47.6)* | 0.8 (0.8 to 0.9) | 7.6% (4.4 to 11.7)* | 1443.8 (1288.9 to 1605.9) | 37.3% (32.7 to 42.8)* | 17.8 (15.9 to 19.7) | 6.3% (2.9 to 10.5)* |
| Liver cancer due to other causes | 63.5 (57.4 to 70.6) | 28.2% (23.6 to 34.3)* | 0.8 (0.7 to 0.9) | -0.9% (-4.2 to 3.6) | 1704.2 (1528.4 to 1903.8) | 21.1% (16.0 to 27.4)* | 20.9 (18.8 to 23.3) | -3.5% (-7.2 to 1.4) |
| Gallbladder and biliary tract cancer | 174.0 (154.2 to 184.9) | 25.0% (21.5 to 28.7)* | 2.2 (2.0 to 2.4) | -6.7% (-9.4 to -4.0)* | 3434.0 (3009.7 to 3660.0) | 21.8% (17.8 to 26.3)* | 42.6 (37.3 to 45.4) | -6.8% (-9.9 to -3.5)* |
| Pancreatic cancer | 441.1 (432.8 to 449.0) | 39.9% (36.7 to 42.6)* | 5.6 (5.5 to 5.7) | 4.8% (2.5 to 6.8)* | 8988.1 (8806.6 to 9162.9) | 35.8% (32.5 to 38.6)* | 111.1 (108.9 to 113.2) | 4.0% (1.5 to 6.1)* |
| Larynx cancer | 126.5 (123.4 to 129.9) | 21.1% (17.8 to 24.4)* | 1.6 (1.5 to 1.6) | -7.7% (-10.1 to -5.2)* | 3170.0 (3089.7 to 3260.3) | 17.3% (13.9 to 20.9)* | 38.5 (37.6 to 39.6) | -9.1% (-11.7 to -6.4)* |
| Tracheal, bronchus, and lung cancer | 1883.1 (1844.2 to 1922.8) | 29.6% (26.5 to 32.5)* | 23.7 (23.3 to 24.2) | -2.0% (-4.3 to 0.1) | 40 391.6 (39 506.7 to 41 285.6) | 24.8% (21.7 to 27.6)* | 496.4 (485.5 to 507.2) | -4.1% (-6.5 to -2.0)* |
| Malignant skin melanoma | 61.7 (47.9 to 70.3) | 23.6% (19.0 to 26.9)* | 0.8 (0.6 to 0.9) | -5.1% (-8.5 to -2.5)* | 1513.2 (1220.7 to 1774.4) | 16.1% (12.7 to 20.0)* | 18.7 (15.1 to 21.9) | -7.2% (-9.8 to -3.8)* |
| Non-melanoma skin cancer | 65.1 (63.1 to 66.5) | 38.6% (34.9 to 41.2)* | 0.8 (0.8 to 0.9) | 2.7% (0.0 to 4.5)* | 1239.1 (1200.2 to 1266.6) | 30.0% (26.2 to 32.7)* | 15.5 (15.0 to 15.8) | 0.5% (-2.3 to 2.6) |
| Non-melanoma skin cancer (squamous-cell carcinoma) | 65.1 (63.1 to 66.5) | 38.6% (34.9 to 41.2)* | 0.8 (0.8 to 0.9) | 2.7% (0.0 to 4.5)* | 1239.1 (1200.2 to 1266.6) | 30.0% (26.2 to 32.7)* | 15.5 (15.0 to 15.8) | 0.5% (-2.3 to 2.6) |
| Breast cancer | 611.6 (589.2 to 640.7) | 27.0% (21.3 to 31.2)* | 7.6 (7.4 to 8.0) | -2.6% (-6.9 to 0.4) | 16 400.7 (15 737.0 to 17 320.2) | 23.9% (17.3 to 28.7)* | 200.2 (192.1 to 211.4) | -1.7% (-6.8 to 2.1) |
| Cervical cancer | 259.7 (241.1 to 269.2) | 18.8% (12.9 to 22.8)* | 3.2 (3.0 to 3.3) | -7.2% (-11.7 to -4.0)* | 7773.5 (7227.4 to 8087.8) | 15.1% (9.4 to 19.1)* | 94.6 (88.1 to 98.5) | -7.2% (-11.8 to -3.9)* |
| Uterine cancer | 85.2 (83.2 to 87.4) | 18.8% (15.8 to 22.5)* | 1.1 (1.0 to 1.1) | -10.4% (-12.5 to -7.7)* | 1930.0 (1879.9 to 1983.0) | 14.8% (11.6 to 19.0)* | 23.7 (23.1 to 24.3) | -11.2% (-13.7 to -8.0)* |
| Ovarian cancer | 176.0 (171.4 to 181.2) | 30.3% (26.8 to 33.7)* | 2.2 (2.1 to 2.3) | -1.0% (-3.6 to 1.6) | 4496.9 (4370.7 to 4642.1) | 29.1% (24.8 to 33.1)* | 54.9 (53.4 to 56.7) | 1.1% (-2.2 to 4.2) |
| Prostate cancer | 415.9 (357.3 to 489.5) | 32.5% (29.3 to 38.4)* | 5.5 (4.7 to 6.5) | -2.5% (-4.9 to 1.9) | 6214.5 (5324.2 to 7293.0) | 28.3% (24.9 to 34.5)* | 79.3 (68.1 to 93.0) | -3.6% (-6.2 to 1.2) |
| Testicular cancer | 7.7 (7.4 to 8.0) | 6.1% (2.3 to 10.9)* | 0.1 (0.1 to 0.1) | -9.4% (-12.6 to -5.2)* | 338.7 (323.8 to 357.4) | 0.9% (-3.3 to 6.3) | 4.3 (4.1 to 4.5) | -10.8% (-14.5 to -6.1)* |
| Kidney cancer | 138.5 (128.7 to 142.5) | 30.1% (26.2 to 34.1)* | 1.8 (1.6 to 1.8) | -1.3% (-4.3 to 1.7) | 3143.3 (2952.2 to 3234.1) | 23.1% (18.5 to 27.3)* | 39.4 (37.0 to 40.5) | -3.3% (-6.9 to 0.0) |
| Bladder cancer | 196.5 (191.5 to 205.8) | 27.8% (25.1 to 30.4)* | 2.6 (2.5 to 2.7) | -5.4% (-7.3 to -3.4)* | 3350.1 (3257.4 to 3511.6) | 22.6% (19.9 to 25.3)* | 42.2 (41.0 to 44.1) | -6.9% (-8.9 to -4.8)* |
| Brain and nervous system cancer | 247.1 (213.0 to 265.0) | 29.2% (23.2 to 33.4)* | 3.1 (2.7 to 3.3) | 3.8% (-1.0 to 7.0) | 8577.8 (7527.0 to 9359.3) | 18.4% (11.9 to 24.6)* | 109.8 (96.1 to 120.0) | 0.0% (-5.6 to 5.3) |
| Thyroid cancer | 41.2 (39.9 to 44.1) | 28.9% (24.3 to 33.3)* | 0.5 (0.5 to 0.6) | -1.2% (-4.5 to 2.0) | 1001.2 (963.6 to 1074.0) | 22.1% (16.7 to 28.0)* | 12.4 (12.0 to 13.4) | -2.3% (-6.6 to 2.4) |
| Mesothelioma | 29.9 (29.1 to 30.6) | 26.9% (20.1 to 32.6)* | 0.4 (0.4 to 0.4) | -3.4% (-8.4 to 0.7) | 655.7 (635.2 to 677.0) | 21.0% (13.8 to 27.3)* | 8.1 (7.9 to 8.4) | -5.4% (-10.8 to -0.8)* |
| Hodgkin lymphoma | 32.6 (27.6 to 38.1) | 0.2% (-3.5 to 3.6) | 0.4 (0.4 to 0.5) | -16.8% (-19.8 to -14.0)* | 1327.6 (1110.1 to 1567.7) | -5.2% (-8.6 to -1.8)* | 17.1 (14.3 to 20.2) | -17.1% (-20.1 to -13.9)* |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|---|---|----------------------------------|---|------------------------------------|--|----------------------------------|---|-------------------------------------|
| | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 |
| (Continued from previous page) | | | | | | | | |
| Non-Hodgkin lymphoma | 248.6 (243.5 to 253.1) | 29.4% (25.5 to 32.4)* | 3.2 (3.1 to 3.2) | 0.1% (-2.7 to 2.4) | 6828.8 (6611.8 to 7020.0) | 22.1% (15.6 to 26.9)* | 86.8 (84.0 to 89.5) | 0.2% (-5.2 to 4.3) |
| Multiple myeloma | 107.1 (98.5 to 118.9) | 32.7% (28.4 to 36.4)* | 1.4 (1.3 to 1.5) | -0.4% (-3.5 to 2.4) | 2234.7 (2091.4 to 2493.2) | 30.4% (25.6 to 34.4)* | 27.7 (25.9 to 30.8) | 0.3% (-3.3 to 3.4) |
| Leukaemia | 347.6 (317.3 to 364.9) | 12.8% (9.5 to 15.6)* | 4.5 (4.1 to 4.7) | -9.6% (-12.2 to -7.4)* | 11712.0 (10531.4 to 12523.3) | 2.3% (-3.7 to 6.2) | 153.4 (137.9 to 164.5) | -12.0% (-17.3 to -8.5)* |
| Acute lymphoid leukaemia | 52.2 (46.0 to 56.7) | 14.1% (2.6 to 23.2)* | 0.7 (0.6 to 0.7) | -1.5% (-11.6 to 6.2) | 2661.7 (2341.7 to 2941.1) | 5.3% (-8.6 to 15.4) | 36.1 (31.7 to 40.0) | -4.7% (-17.6 to 4.7) |
| Chronic lymphoid leukaemia | 35.2 (33.5 to 36.9) | 21.4% (17.7 to 25.0)* | 0.5 (0.4 to 0.5) | -10.3% (-13.0 to -7.6)* | 634.1 (595.7 to 674.2) | 18.3% (14.2 to 22.4)* | 8.0 (7.5 to 8.5) | -9.2% (-12.3 to -6.1)* |
| Acute myeloid leukaemia | 99.9 (91.3 to 104.6) | 24.6% (17.1 to 29.8)* | 1.3 (1.2 to 1.3) | -1.0% (-6.6 to 3.0) | 3192.6 (2868.8 to 3405.6) | 16.2% (4.4 to 24.6)* | 41.3 (37.0 to 44.1) | -1.4% (-11.3 to 5.8) |
| Chronic myeloid leukaemia | 24.1 (22.2 to 26.1) | 3.3% (0.4 to 6.4)* | 0.3 (0.3 to 0.3) | -19.9% (-22.2 to -17.6)* | 643.3 (583.4 to 699.1) | -1.7% (-5.2 to 1.5) | 8.0 (7.3 to 8.7) | -19.7% (-22.4 to -17.1)* |
| Other leukaemia | 136.2 (121.0 to 146.8) | 4.9% (0.9 to 9.7)* | 1.8 (1.6 to 1.9) | -15.6% (-18.7 to -12.1)* | 4580.2 (3955.1 to 5013.3) | -8.1% (-14.6 to -1.8)* | 60.0 (51.9 to 65.7) | -20.8% (-26.5 to -15.4)* |
| Other malignant cancers | 359.5 (331.4 to 370.8) | 26.8% (23.3 to 29.5)* | 4.6 (4.2 to 4.8) | 0.1% (-2.6 to 2.2) | 11189.0 (10386.5 to 11664.8) | 18.4% (12.8 to 22.8)* | 144.4 (133.8 to 150.9) | -0.3% (-5.1 to 3.5) |
| Other neoplasms | 102.9 (80.2 to 122.4) | 42.0% (35.6 to 51.7)* | 1.3 (1.0 to 1.6) | 7.4% (2.1 to 15.8)* | 2425.8 (2024.4 to 2932.1) | 32.9% (25.9 to 42.7)* | 31.1 (25.9 to 37.4) | 7.9% (2.0 to 16.5)* |
| Myelodysplastic, myeloproliferative, and other haemopoietic neoplasms | 98.8 (76.7 to 118.1) | 42.6% (36.2 to 52.2)* | 1.3 (1.0 to 1.5) | 7.1% (1.8 to 15.3)* | 2189.1 (1820.8 to 2665.5) | 33.9% (26.6 to 43.3)* | 27.9 (23.2 to 33.8) | 7.2% (1.2 to 15.6)* |
| Other benign and in-situ neoplasms | 4.1 (3.2 to 4.8) | 29.6% (17.2 to 44.5)* | 0.1 (0.0 to 0.1) | 15.5% (4.1 to 29.2)* | 236.8 (186.4 to 277.7) | 25.0% (12.7 to 38.6)* | 3.2 (2.5 to 3.7) | 14.3% (3.0 to 27.0)* |
| Cardiovascular diseases | 17790.9 (17527.1 to 18042.7) | 21.1% (19.7 to 22.6)* | 233.1 (229.7 to 236.4) | -10.3% (-11.4 to -9.3)* | 330172.6 (324899.3 to 335159.9) | 14.7% (13.3 to 16.2)* | 4148.0 (4082.0 to 4210.8) | -11.3% (-12.4 to -10.1)* |
| Rheumatic heart disease | 285.5 (266.2 to 303.3) | 1.3% (-3.9 to 6.0) | 3.7 (3.4 to 3.9) | -21.3% (-25.2 to -17.8)* | 7492.6 (6926.7 to 8046.7) | -10.2% (-15.4 to -6.2)* | 94.5 (87.5 to 101.4) | -25.9% (-30.0 to -22.7)* |
| Ischaemic heart disease | 8930.4 (8790.7 to 9138.7) | 22.3% (20.6 to 23.8)* | 116.9 (115.1 to 119.7) | -9.7% (-11.0 to -8.7)* | 164983.4 (162168.9 to 168584.2) | 17.3% (15.4 to 19.0)* | 2065.9 (2030.6 to 2111.7) | -9.8% (-11.2 to -8.5)* |
| Stroke | 6167.3 (6044.3 to 6327.6) | 16.6% (14.7 to 18.6)* | 80.5 (78.9 to 82.6) | -13.6% (-15.0 to -12.1)* | 113355.9 (110957.8 to 116180.6) | 12.1% (9.9 to 14.1)* | 1422.2 (1392.0 to 1457.7) | -13.8% (-15.5 to -12.3)* |
| Ischaemic stroke | 2747.4 (2657.1 to 2857.6) | 21.2% (19.0 to 23.3)* | 36.6 (35.5 to 38.0) | -11.8% (-13.4 to -10.3)* | 40834.1 (39133.3 to 43140.9) | 16.9% (14.3 to 19.3)* | 521.8 (500.5 to 550.2) | -12.0% (-13.9 to -10.3)* |
| Intracerebral haemorrhage | 2974.9 (2880.8 to 3072.8) | 12.5% (9.6 to 15.1)* | 38.2 (37.0 to 39.4) | -15.7% (-17.8 to -13.8)* | 61562.6 (59598.2 to 63531.4) | 9.3% (6.5 to 11.8)* | 764.1 (739.7 to 788.4) | -15.4% (-17.6 to -13.5)* |
| Subarachnoid haemorrhage | 445.0 (417.2 to 492.3) | 18.4% (13.4 to 24.6)* | 5.7 (5.3 to 6.3) | -9.4% (-13.1 to -4.9)* | 10959.3 (10294.3 to 12264.1) | 10.7% (6.8 to 16.5)* | 136.4 (128.2 to 152.5) | -11.4% (-14.5 to -7.0)* |
| Hypertensive heart disease | 925.7 (681.4 to 994.9) | 46.6% (26.3 to 59.3)* | 12.3 (9.0 to 13.2) | 7.5% (-7.3 to 16.3) | 15135.2 (11349.8 to 16311.7) | 35.7% (19.1 to 47.9)* | 191.5 (143.3 to 206.2) | 3.8% (-8.8 to 12.9) |
| Non-rheumatic valvular heart disease | 144.9 (121.8 to 150.4) | 31.8% (27.7 to 34.7)* | 2.0 (1.6 to 2.0) | -5.3% (-7.9 to -3.2)* | 2168.4 (1980.3 to 2322.7) | 21.8% (18.6 to 25.0)* | 27.9 (25.4 to 29.6) | -6.2% (-8.5 to -3.8)* |
| Non-rheumatic calcific aortic valve disease | 102.7 (82.7 to 108.0) | 40.0% (33.0 to 44.9)* | 1.4 (1.1 to 1.5) | -1.0% (-5.6 to 2.2) | 1345.1 (1185.5 to 1432.5) | 30.4% (25.1 to 35.3)* | 17.5 (15.3 to 18.6) | -1.7% (-5.3 to 1.6) |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|---|--------------------------------------|----------------------------------|---|-------------------------------------|--|--------------------------------|---|-------------------------------------|
| | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 |
| (Continued from previous page) | | | | | | | | |
| Non-rheumatic degenerative mitral valve disease | 35.7 (30.5 to 42.5) | 16.4% (11.0 to 23.4)* | 0.5 (0.4 to 0.6) | -14.0% (-18.1 to -8.6)* | 683.6 (592.6 to 787.0) | 10.3% (4.9 to 16.2)* | 8.7 (7.5 to 10.0) | -13.0% (-16.9 to -8.3)* |
| Other non-rheumatic valve diseases | 6.4 (4.9 to 8.7) | 9.7% (-4.1 to 42.2) | 0.1 (0.1 to 0.1) | -17.8% (-28.5 to 8.0) | 139.7 (105.8 to 187.5) | 8.1% (-2.4 to 27.6) | 1.8 (1.4 to 2.4) | -12.4% (-21.3 to 4.7) |
| Cardiomyopathy and myocarditis | 368.5 (341.9 to 386.9) | 8.1% (3.8 to 18.2)* | 4.8 (4.5 to 5.0) | -16.6% (-19.8 to -9.4)* | 9623.3 (8867.5 to 10 208.8) | -5.1% (-9.6 to 5.5) | 122.4 (113.0 to 129.7) | -21.5% (-25.1 to -13.0)* |
| Myocarditis | 46.5 (39.7 to 51.8) | 14.4% (5.6 to 29.7)* | 0.6 (0.5 to 0.7) | -13.3% (-20.4 to -0.1)* | 1259.3 (1100.1 to 1415.5) | -0.3% (-6.9 to 7.6) | 16.6 (14.5 to 18.5) | -15.2% (-21.1 to -7.7)* |
| Alcoholic cardiomyopathy | 88.9 (80.9 to 96.3) | -25.3% (-29.5 to -8.3)* | 1.1 (1.0 to 1.2) | -40.5% (-43.7 to -27.6)* | 2849.2 (2599.0 to 3073.1) | -30.7% (-34.7 to -12.1)* | 34.7 (31.7 to 37.5) | -43.2% (-46.5 to -28.2)* |
| Other cardiomyopathy | 233.2 (213.7 to 248.3) | 28.5% (24.5 to 32.4)* | 3.1 (2.8 to 3.3) | -3.6% (-6.7 to -0.7)* | 5514.8 (4946.7 to 5992.9) | 15.7% (10.9 to 19.9)* | 71.1 (64.0 to 77.0) | -5.4% (-9.3 to -2.0)* |
| Atrial fibrillation and flutter | 287.2 (276.4 to 304.8) | 47.8% (45.4 to 50.6)* | 4.0 (3.9 to 4.2) | 2.6% (0.9 to 4.6)* | 3054.5 (2923.0 to 3235.4) | 40.5% (37.9 to 43.4)* | 40.6 (38.9 to 43.1) | 2.2% (0.3 to 4.2)* |
| Aortic aneurysm | 167.2 (159.8 to 174.1) | 23.7% (19.9 to 27.6)* | 2.2 (2.1 to 2.3) | -8.5% (-11.2 to -5.8)* | 3039.9 (2877.2 to 3186.4) | 19.0% (14.5 to 23.6)* | 38.2 (36.2 to 40.0) | -8.5% (-11.9 to -5.1)* |
| Peripheral vascular disease | 70.2 (43.2 to 123.3) | 55.7% (31.0 to 74.2)* | 1.0 (0.6 to 1.7) | 10.5% (-6.8 to 24.1) | 916.9 (576.9 to 1540.0) | 48.3% (25.0 to 65.6)* | 11.8 (7.4 to 20.0) | 9.7% (-7.5 to 22.6) |
| Endocarditis | 83.4 (74.3 to 94.3) | 32.2% (25.2 to 36.8)* | 1.1 (1.0 to 1.2) | 1.0% (-4.0 to 5.0) | 2174.5 (2033.2 to 2373.0) | 16.9% (8.9 to 22.2)* | 28.3 (26.4 to 30.9) | -2.3% (-8.8 to 2.1) |
| Other cardiovascular and circulatory diseases | 360.7 (338.1 to 392.9) | 21.9% (17.9 to 24.8)* | 4.7 (4.4 to 5.1) | -7.9% (-10.9 to -5.9)* | 8228.0 (7681.4 to 9061.9) | 12.6% (9.5 to 15.7)* | 104.7 (97.8 to 115.2) | -9.4% (-12.0 to -7.1)* |
| Chronic respiratory diseases | 3914.2 (3790.6 to 4044.8) | 15.8% (12.7 to 19.3)* | 51.4 (49.7 to 53.1) | -14.2% (-16.5 to -11.5)* | 68 004.9 (65 869.4 to 70 592.2) | 9.7% (7.0 to 13.2)* | 861.9 (835.4 to 895.0) | -15.7% (-17.7 to -13.0)* |
| Chronic obstructive pulmonary disease | 3197.8 (3029.0 to 3358.9) | 17.5% (13.3 to 21.1)* | 42.2 (40.0 to 44.2) | -13.6% (-16.5 to -11.0)* | 50 990.0 (47 678.7 to 54 146.9) | 13.2% (8.8 to 16.9)* | 647.3 (605.9 to 686.4) | -14.3% (-17.5 to -11.6)* |
| Pneumoconiosis | 21.6 (20.5 to 22.7) | 10.7% (5.1 to 16.6)* | 0.3 (0.3 to 0.3) | -16.7% (-20.8 to -12.4)* | 426.9 (403.6 to 452.9) | 7.9% (1.8 to 14.6)* | 5.3 (5.0 to 5.6) | -16.4% (-21.1 to -11.3)* |
| Silicosis | 11.3 (10.4 to 12.5) | 12.0% (1.2 to 22.8)* | 0.1 (0.1 to 0.2) | -15.5% (-23.6 to -7.4)* | 235.7 (210.3 to 258.2) | 11.8% (-0.7 to 23.6) | 2.9 (2.6 to 3.2) | -13.4% (-23.1 to -4.3)* |
| Asbestosis | 3.4 (2.3 to 3.9) | 23.3% (15.1 to 33.9)* | 0.0 (0.0 to 0.1) | -8.3% (-14.1 to -0.4)* | 54.6 (38.6 to 65.6) | 15.6% (7.4 to 28.5)* | 0.7 (0.5 to 0.8) | -11.4% (-17.5 to -1.3)* |
| Coal worker pneumoconiosis | 3.2 (2.9 to 4.0) | -2.2% (-12.0 to 11.7) | 0.0 (0.0 to 0.1) | -26.6% (-33.8 to -16.7)* | 58.9 (52.2 to 76.4) | -6.4% (-16.3 to 8.3) | 0.7 (0.7 to 1.0) | -27.9% (-35.4 to -16.9)* |
| Other pneumoconiosis | 3.6 (3.1 to 4.5) | 8.9% (0.0 to 25.4)* | 0.0 (0.0 to 0.1) | -17.5% (-24.1 to -5.0)* | 77.6 (66.1 to 96.4) | 4.2% (-3.8 to 19.5) | 1.0 (0.8 to 1.2) | -18.3% (-24.7 to -5.9)* |
| Asthma | 495.1 (338.2 to 641.2) | -0.7% (-6.2 to 8.1) | 6.3 (4.3 to 8.2) | -23.9% (-28.1 to -17.2)* | 12 139.9 (8538.5 to 15 576.3) | -7.5% (-11.4 to -1.6)* | 152.8 (108.3 to 195.8) | -25.8% (-28.9 to -20.4)* |
| Interstitial lung disease and pulmonary sarcoidosis | 147.6 (114.9 to 181.3) | 49.8% (39.0 to 58.6)* | 1.9 (1.5 to 2.4) | 11.4% (4.0 to 17.9)* | 2716.7 (2156.9 to 3371.3) | 43.0% (32.1 to 53.4)* | 34.2 (27.1 to 42.4) | 10.4% (2.3 to 18.6)* |
| Other chronic respiratory diseases | 52.1 (45.9 to 59.6) | 21.3% (14.1 to 34.2)* | 0.7 (0.6 to 0.8) | -3.2% (-8.7 to 6.7) | 1731.4 (1504.5 to 1998.9) | 10.8% (3.2 to 24.3)* | 22.1 (19.3 to 25.5) | -6.3% (-12.6 to 5.3) |
| Digestive diseases | 2377.7 (2295.1 to 2518.0) | 15.3% (12.1 to 19.7)* | 30.3 (29.2 to 32.1) | -10.7% (-13.1 to -7.3)* | 65 348.4 (62 343.9 to 69 371.3) | 7.5% (4.2 to 11.9)* | 819.8 (781.7 to 869.7) | -12.2% (-14.9 to -8.5)* |
| Cirrhosis and other chronic liver diseases | 1322.9 (1268.2 to 1449.1) | 15.0% (8.7 to 21.5)* | 16.5 (15.8 to 18.1) | -9.7% (-14.7 to -4.6)* | 39 652.4 (37 985.2 to 43 624.9) | 8.9% (3.4 to 14.4)* | 488.9 (468.0 to 537.5) | -11.3% (-15.8 to -6.9)* |
| Cirrhosis and other chronic liver diseases due to hepatitis B | 384.0 (349.1 to 441.7) | 8.6% (1.1 to 17.3)* | 4.8 (4.3 to 5.5) | -14.3% (-20.2 to -7.3)* | 11 721.5 (10 648.0 to 13 431.7) | 3.4% (-3.3 to 10.7) | 144.1 (130.8 to 165.3) | -15.5% (-20.9 to -9.5)* |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|--|--|--|---|--------------------------------------|---|--|---|--|
| | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 |
| (Continued from previous page) | | | | | | | | |
| Cirrhosis and other chronic liver diseases due to hepatitis C | 342.2 (312.6 to 381.1) | 17.4% (11.3 to 23.0)* | 4.2 (3.9 to 4.7) | -8.4% (-13.0 to -3.9)* | 9980.1 (9074.7 to 11116.9) | 12.2% (6.8 to 17.3)* | 121.9 (111.0 to 135.8) | -9.6% (-13.9 to -5.5)* |
| Cirrhosis and other chronic liver diseases due to alcohol use | 332.3 (303.0 to 373.3) | 16.9% (11.2 to 23.7)* | 4.1 (3.7 to 4.6) | -8.8% (-13.2 to -3.4)* | 9785.4 (8919.3 to 10962.1) | 12.3% (7.1 to 18.3)* | 119.0 (108.6 to 133.5) | -10.0% (-14.2 to -5.2)* |
| Cirrhosis due to NASH | 118.0 (108.6 to 128.6) | 27.6% (21.2 to 33.3)* | 1.5 (1.3 to 1.6) | -1.4% (-6.3 to 3.1) | 3285.5 (3011.9 to 3586.8) | 22.2% (16.6 to 27.2)* | 40.0 (36.6 to 43.6) | -3.0% (-7.4 to 1.0) |
| Cirrhosis and other chronic liver diseases due to other causes | 146.4 (130.9 to 164.6) | 14.2% (8.2 to 20.2)* | 1.9 (1.7 to 2.1) | -8.6% (-13.4 to -3.8)* | 4880.0 (4392.5 to 5457.1) | 2.1% (-4.3 to 10.7) | 63.9 (57.5 to 71.4) | -12.0% (-17.5 to -4.5)* |
| Upper digestive system diseases | 292.1 (279.7 to 312.3) | 2.9% (-1.3 to 8.6) | 3.8 (3.6 to 4.0) | -21.6% (-24.8 to -17.3)* | 6789.9 (6413.1 to 7259.0) | -4.5% (-9.5 to 1.8) | 85.2 (80.4 to 91.2) | -23.3% (-27.3 to -18.4)* |
| Peptic ulcer disease | 240.3 (229.4 to 258.8) | 0.6% (-3.6 to 5.6) | 3.1 (3.0 to 3.3) | -23.5% (-26.6 to -19.7)* | 5513.3 (5202.4 to 5947.8) | -6.8% (-11.4 to -1.5)* | 69.1 (65.1 to 74.7) | -25.4% (-29.0 to -21.0)* |
| Gastritis and duodenitis | 51.8 (43.0 to 56.9) | 15.5% (7.5 to 28.9)* | 0.7 (0.6 to 0.7) | -11.7% (-17.6 to -2.2)* | 1276.6 (1047.1 to 1419.7) | 6.8% (-3.1 to 22.4) | 16.1 (13.2 to 17.9) | -13.2% (-21.1 to -1.3)* |
| Appendicitis | 43.9 (40.2 to 47.5) | 1.8% (-4.0 to 9.6) | 0.6 (0.5 to 0.6) | -17.0% (-21.5 to -10.7)* | 1633.2 (1473.2 to 1772.7) | -8.7% (-16.7 to 0.6) | 21.4 (19.3 to 23.3) | -20.1% (-27.2 to -12.1)* |
| Paralytic ileus and intestinal obstruction | 240.5 (198.7 to 261.6) | 21.1% (14.4 to 29.0)* | 3.2 (2.7 to 3.5) | -5.8% (-11.0 to 0.3) | 7245.9 (5866.8 to 7980.6) | 6.5% (-3.1 to 15.5) | 97.0 (78.9 to 106.8) | -8.7% (-16.8 to -0.8)* |
| Inguinal, femoral, and abdominal hernia | 44.2 (38.6 to 50.0) | 21.7% (16.2 to 28.4)* | 0.6 (0.5 to 0.7) | -8.9% (-12.9 to -4.2)* | 914.3 (792.8 to 1021.9) | 12.1% (4.5 to 20.4)* | 11.7 (10.1 to 13.1) | -10.6% (-16.5 to -3.9)* |
| Inflammatory bowel disease | 38.6 (31.6 to 41.2) | 20.4% (11.5 to 27.2)* | 0.5 (0.4 to 0.5) | -10.5% (-16.0 to -5.9)* | 829.7 (711.4 to 900.7) | 10.3% (-2.7 to 19.5) | 10.7 (9.1 to 11.7) | -11.3% (-20.7 to -4.5)* |
| Vascular intestinal disorders | 96.1 (89.0 to 100.8) | 22.6% (17.0 to 28.1)* | 1.3 (1.2 to 1.3) | -10.2% (-14.2 to -6.2)* | 1570.1 (1433.3 to 1667.3) | 17.6% (10.7 to 24.8)* | 20.0 (18.3 to 21.3) | -10.0% (-15.3 to -5.0)* |
| Gallbladder and biliary diseases | 110.5 (105.5 to 116.6) | 28.8% (25.3 to 33.8)* | 1.5 (1.4 to 1.6) | -5.0% (-7.5 to -1.7)* | 1983.2 (1863.2 to 2092.0) | 18.5% (13.4 to 25.3)* | 25.4 (23.8 to 26.8) | -6.9% (-10.9 to -1.8)* |
| Pancreatitis | 101.6 (89.5 to 108.3) | 20.6% (16.4 to 25.7)* | 1.3 (1.1 to 1.4) | -5.7% (-9.0 to -1.7)* | 2890.0 (2537.1 to 3102.9) | 13.8% (8.7 to 19.5)* | 35.8 (31.4 to 38.4) | -6.8% (-10.9 to -2.1)* |
| Other digestive diseases | 87.3 (81.9 to 93.3) | 25.4% (18.1 to 32.3)* | 1.2 (1.1 to 1.2) | -7.1% (-12.1 to -2.4)* | 1839.7 (1663.9 to 2038.5) | 16.4% (5.8 to 27.4)* | 23.7 (21.5 to 26.3) | -6.5% (-14.9 to 1.8) |
| Neurological disorders | 3094.2 (3039.6 to 3142.6) | 42.1% (40.2 to 43.9)* | 43.1 (42.3 to 43.7) | 0.1% (-1.2 to 1.3) | 38004.5 (37134.8 to 39174.6) | 26.2% (23.9 to 30.2)* | 507.6 (496.1 to 523.4) | -3.1% (-4.8 to -0.1)* |
| Alzheimer's disease and other dementias | 2514.6 (2470.5 to 2550.3) | 46.2% (43.9 to 48.0)* | 35.4 (34.8 to 35.9) | 0.6% (-0.9 to 1.8) | 23951.1 (23523.6 to 24326.8) | 38.6% (35.7 to 40.9)* | 323.7 (317.9 to 328.7) | -0.3% (-2.3 to 1.2) |
| Parkinson's disease | 340.6 (324.4 to 355.1) | 38.3% (33.3 to 41.4)* | 4.6 (4.4 to 4.8) | 0.8% (-2.8 to 3.0) | 4361.2 (4182.8 to 4578.7) | 33.8% (28.5 to 37.0)* | 56.9 (54.5 to 59.8) | 0.3% (-3.6 to 2.6) |
| Epilepsy | 130.2 (117.0 to 150.8) | 3.8% (-1.6 to 15.7) | 1.7 (1.5 to 2.0) | -10.7% (-15.4 to -0.5)* | 6232.1 (5709.8 to 7289.7) | -5.5% (-11.6 to 8.3) | 82.6 (75.5 to 96.6) | -14.9% (-20.6 to -2.1)* |
| Multiple sclerosis | 20.7 (17.7 to 22.2) | 22.4% (8.0 to 27.8)* | 0.3 (0.2 to 0.3) | -3.9% (-14.5 to 0.4) | 628.2 (563.0 to 682.4) | 17.1% (4.1 to 24.5)* | 7.7 (6.9 to 8.3) | -5.5% (-15.1 to 0.6) |
| Motor neuron disease | 34.1 (32.8 to 37.1) | 32.7% (28.0 to 37.0)* | 0.4 (0.4 to 0.5) | 1.2% (-2.4 to 4.5) | 828.1 (796.7 to 917.1) | 27.2% (22.6 to 31.3)* | 10.3 (9.9 to 11.4) | 0.1% (-3.5 to 3.3) |
| Other neurological disorders | 53.9 (51.6 to 59.0) | 25.4% (17.8 to 32.3)* | 0.7 (0.7 to 0.8) | 2.0% (-3.9 to 6.8) | 2003.8 (1856.8 to 2269.5) | 11.4% (3.6 to 21.1)* | 26.5 (24.3 to 30.1) | -2.8% (-9.3 to 5.1) |
| Mental disorders | 0.3 (0.3 to 0.4) | 19.9% (10.0 to 29.2)* | 0.0 (0.0 to 0.0) | 7.5% (-1.4 to 15.9) | 17.5 (15.9 to 19.2) | 18.5% (8.8 to 27.5)* | 0.2 (0.2 to 0.2) | 7.2% (-1.6 to 15.3) |
| Eating disorders | 0.3 (0.3 to 0.4) | 19.9% (10.0 to 29.2)* | 0.0 (0.0 to 0.0) | 7.5% (-1.4 to 15.9) | 17.5 (15.9 to 19.2) | 18.5% (8.8 to 27.5)* | 0.2 (0.2 to 0.2) | 7.2% (-1.6 to 15.3) |
| Anorexia nervosa | 0.2 (0.2 to 0.3) | 17.6% (7.0 to 27.6)* | 0.0 (0.0 to 0.0) | 5.5% (-4.1 to 14.4) | 12.7 (10.9 to 14.1) | 15.9% (5.6 to 25.6)* | 0.2 (0.1 to 0.2) | 5.0% (-4.4 to 13.7) |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|--|--|--|---|--------------------------------------|--|--|---|--------------------------------------|
| | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 |
| (Continued from previous page) | | | | | | | | |
| Bulimia nervosa | 0.1 (0.1 to 0.1) | 26.4% (12.9 to 40.5)* | 0.0 (0.0 to 0.0) | 13.5% (1.0 to 26.2)* | 4.8 (4.0 to 6.7) | 25.9% (12.0 to 40.0)* | 0.1 (0.1 to 0.1) | 13.6% (1.1 to 26.3)* |
| Substance use disorders | 351.5 (334.1 to 362.7) | 23.8% (20.2 to 27.3)* | 4.3 (4.1 to 4.5) | 2.0% (-1.0 to 5.0) | 13 597.6 (12 979.5 to 14 033.3) | 18.8% (15.3 to 22.4)* | 168.0 (160.4 to 173.3) | 0.8% (-2.2 to 3.9) |
| Alcohol use disorders | 184.9 (166.7 to 193.0) | 2.7% (-2.2 to 7.7) | 2.3 (2.0 to 2.4) | -16.5% (-20.4 to -12.4)* | 6750.4 (6113.2 to 7082.7) | -2.1% (-7.2 to 3.3) | 82.4 (74.7 to 86.5) | -18.4% (-22.7 to -13.9)* |
| Drug use disorders | 166.6 (163.4 to 170.3) | 60.2% (56.9 to 63.6)* | 2.1 (2.0 to 2.1) | 34.1% (31.4 to 36.9)* | 6847.2 (6704.5 to 7004.4) | 50.4% (47.0 to 54.0)* | 85.5 (83.7 to 87.5) | 30.5% (27.6 to 33.5)* |
| Opioid use disorders | 109.5 (105.7 to 113.6) | 77.0% (68.8 to 88.5)* | 1.4 (1.3 to 1.4) | 49.4% (42.5 to 59.2)* | 4641.2 (4480.6 to 4818.9) | 65.0% (57.3 to 75.0)* | 58.0 (56.1 to 60.3) | 43.9% (37.1 to 52.6)* |
| Cocaine use disorders | 7.3 (6.6 to 8.1) | 42.2% (30.1 to 58.3)* | 0.1 (0.1 to 0.1) | 19.6% (9.2 to 33.0)* | 311.5 (281.5 to 344.1) | 35.6% (24.0 to 51.2)* | 3.9 (3.5 to 4.3) | 16.7% (6.5 to 30.0)* |
| Amphetamine use disorders | 4.5 (3.3 to 5.0) | 27.2% (0.8 to 41.0)* | 0.1 (0.0 to 0.1) | 8.7% (-14.0 to 20.7) | 206.9 (151.6 to 227.8) | 21.0% (-3.6 to 34.4) | 2.6 (1.9 to 2.8) | 5.6% (-15.5 to 17.4) |
| Other drug use disorders | 45.3 (42.9 to 48.2) | 35.2% (22.8 to 46.1)* | 0.6 (0.5 to 0.6) | 11.3% (1.2 to 19.9)* | 1687.6 (1589.4 to 1805.9) | 25.9% (14.0 to 37.3)* | 21.0 (19.8 to 22.5) | 8.2% (-2.0 to 17.8) |
| Diabetes and kidney diseases | 2611.2 (2557.8 to 2667.2) | 34.2% (32.0 to 36.2)* | 33.6 (32.9 to 34.3) | 1.3% (-0.3 to 2.7) | 58 116.9 (56 801.5 to 59 525.7) | 25.1% (23.0 to 27.2)* | 726.4 (710.0 to 744.4) | -1.1% (-2.8 to 0.6) |
| Diabetes mellitus | 1369.8 (1340.3 to 1401.9) | 34.7% (32.2 to 37.3)* | 17.5 (17.1 to 17.9) | 1.2% (-0.7 to 3.1) | 29 300.2 (28 711.5 to 29 950.1) | 29.9% (27.2 to 32.4)* | 363.1 (355.7 to 371.2) | 0.7% (-1.4 to 2.6) |
| Type 1 diabetes mellitus | 345.5 (319.3 to 371.1) | 15.1% (10.5 to 19.0)* | 4.3 (4.0 to 4.7) | -11.0% (-14.6 to -7.8)* | 9477.3 (8944.6 to 10 079.9) | 11.1% (7.2 to 14.3)* | 117.3 (110.8 to 124.6) | -10.6% (-13.9 to -7.9)* |
| Type 2 diabetes mellitus | 1024.3 (985.5 to 1066.8) | 43.0% (40.4 to 45.8)* | 13.2 (12.7 to 13.7) | 5.9% (4.1 to 8.0)* | 19 822.9 (19 013.8 to 20 687.8) | 41.3% (38.3 to 44.4)* | 245.8 (235.8 to 256.5) | 7.1% (5.0 to 9.4)* |
| Chronic kidney disease | 1230.2 (1195.1 to 1258.8) | 33.7% (30.5 to 36.1)* | 15.9 (15.5 to 16.3) | 1.5% (-0.9 to 3.2) | 28 508.5 (27 610.2 to 29 314.0) | 21.0% (18.2 to 23.5)* | 359.4 (348.2 to 369.6) | -2.5% (-4.7 to -0.6)* |
| Chronic kidney disease due to type 1 diabetes mellitus | 77.3 (62.4 to 95.2) | 23.2% (19.0 to 27.4)* | 0.9 (0.8 to 1.2) | -1.2% (-4.0 to 1.2) | 2622.0 (2121.7 to 3205.5) | 17.8% (13.6 to 22.3)* | 31.9 (25.9 to 38.9) | -2.9% (-5.6 to -0.3)* |
| Chronic kidney disease due to type 2 diabetes mellitus | 349.0 (306.8 to 395.9) | 40.5% (36.4 to 43.6)* | 4.5 (4.0 to 5.1) | 4.2% (1.4 to 6.2)* | 6671.9 (5825.5 to 7625.9) | 35.4% (31.0 to 38.7)* | 82.8 (72.4 to 94.5) | 2.9% (-0.2 to 5.2) |
| Chronic kidney disease due to hypertension | 347.4 (304.6 to 391.5) | 41.4% (37.4 to 44.2)* | 4.6 (4.0 to 5.2) | 3.2% (0.4 to 5.2)* | 5954.8 (5175.1 to 6741.9) | 33.4% (29.3 to 36.5)* | 75.2 (65.4 to 84.9) | 2.3% (-0.7 to 4.5) |
| Chronic kidney disease due to glomerulonephritis | 189.7 (165.2 to 217.3) | 25.5% (22.1 to 28.8)* | 2.4 (2.1 to 2.8) | -1.3% (-3.2 to 0.7) | 5554.9 (4929.1 to 6250.8) | 12.7% (9.6 to 16.1)* | 70.6 (62.8 to 79.4) | -5.5% (-7.5 to -3.3)* |
| Chronic kidney disease due to other and unspecified causes | 266.8 (232.8 to 304.0) | 25.9% (22.4 to 29.4)* | 3.4 (3.0 to 3.9) | -1.4% (-3.7 to 0.6) | 7704.8 (6794.9 to 8614.8) | 10.0% (6.8 to 13.4)* | 98.9 (87.4 to 110.0) | -7.7% (-9.9 to -5.4)* |
| Acute glomerulonephritis | 11.2 (10.5 to 12.1) | 14.7% (8.7 to 22.3)* | 0.1 (0.1 to 0.2) | -9.5% (-14.5 to -3.5)* | 308.2 (282.4 to 336.8) | -5.5% (-10.4 to 2.2) | 3.9 (3.6 to 4.3) | -20.9% (-25.1 to -15.1)* |
| Skin and subcutaneous diseases | 100.3 (65.3 to 131.7) | 42.3% (34.9 to 52.0)* | 1.3 (0.9 to 1.7) | 8.1% (2.7 to 16.5)* | 2517.9 (1703.3 to 3283.8) | 26.1% (18.6 to 35.7)* | 33.1 (22.4 to 43.2) | 5.0% (-1.2 to 13.8) |
| Bacterial skin diseases | 76.0 (48.7 to 95.6) | 45.5% (36.8 to 54.9)* | 1.0 (0.6 to 1.3) | 12.7% (6.0 to 20.7)* | 2096.6 (1378.0 to 2691.9) | 26.4% (18.0 to 36.9)* | 27.6 (18.2 to 35.6) | 6.4% (-0.6 to 15.9) |
| Cellulitis | 18.9 (10.3 to 26.0) | 57.0% (45.8 to 67.1)* | 0.2 (0.1 to 0.3) | 19.6% (9.8 to 28.2)* | 480.1 (264.6 to 640.2) | 38.3% (30.8 to 50.4)* | 6.2 (3.4 to 8.3) | 13.7% (7.3 to 23.9)* |
| Pyoderma | 57.1 (35.8 to 70.8) | 42.1% (32.4 to 52.4)* | 0.8 (0.5 to 0.9) | 10.5% (3.2 to 19.0)* | 1616.4 (1051.6 to 2136.7) | 23.3% (14.3 to 35.0)* | 21.5 (14.1 to 28.8) | 4.5% (-3.2 to 15.0) |
| Decubitus ulcer | 20.3 (13.2 to 30.6) | 32.4% (22.9 to 51.0)* | 0.3 (0.2 to 0.4) | -5.1% (-12.2 to 9.2) | 321.7 (211.2 to 471.5) | 26.2% (17.9 to 42.5)* | 4.2 (2.7 to 6.1) | -2.3% (-8.8 to 11.5) |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|---|--|--|---|--|--|--|--|---|
| | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 |
| (Continued from previous page) | | | | | | | | |
| Other skin and subcutaneous diseases | 3.9 (2.6 to 7.2) | 35.8% (26.6 to 49.6)* | 0.1 (0.0 to 0.1) | 3.3% (-3.5 to 14.4) | 99.6 (69.4 to 165.8) | 19.1% (10.8 to 34.1)* | 1.3 (0.9 to 2.2) | 0.7% (-6.1 to 13.1) |
| Musculoskeletal disorders | 121.3 (105.6 to 126.2) | 30.9% (25.1 to 35.1)* | 1.6 (1.4 to 1.6) | -0.1% (-4.4 to 3.2) | 2842.7 (2440.7 to 2953.1) | 19.6% (13.7 to 23.2)* | 35.9 (30.8 to 37.3) | -2.5% (-7.1 to 0.4) |
| Rheumatoid arthritis | 47.3 (39.0 to 51.2) | 25.8% (16.2 to 31.9)* | 0.6 (0.5 to 0.7) | -5.9% (-12.9 to -1.2)* | 866.0 (707.8 to 941.4) | 17.9% (8.6 to 23.3)* | 10.9 (8.9 to 11.8) | -9.1% (-16.1 to -5.0)* |
| Other musculoskeletal disorders | 74.0 (66.1 to 78.7) | 34.4% (30.2 to 38.8)* | 1.0 (0.9 to 1.0) | 3.9% (0.9 to 7.5)* | 1976.6 (1730.3 to 2089.1) | 20.3% (15.6 to 24.0)* | 25.0 (21.9 to 26.4) | 0.8% (-3.0 to 3.8) |
| Other non-communicable diseases | 1153.3 (1101.8 to 1208.3) | 0.8% (-3.9 to 4.0) | 16.3 (15.5 to 17.1) | -11.2% (-15.3 to -8.5)* | 68 240.8 (64 835.4 to 72 452.1) | -10.6% (-15.8 to -6.9)* | 993.0 (941.3 to 1054.3) | -16.4% (-21.3 to -12.8)* |
| Congenital anomalies | 584.9 (556.3 to 618.3) | -14.3% (-21.1 to -10.1)* | 8.7 (8.2 to 9.2) | -18.2% (-24.7 to -14.1)* | 48 860.4 (46 405.7 to 51 687.3) | -15.3% (-22.0 to -11.0)* | 729.4 (692.5 to 771.7) | -18.8% (-25.2 to -14.6)* |
| Neural tube defects | 61.7 (46.7 to 83.7) | -13.1% (-24.5 to -1.0)* | 0.9 (0.7 to 1.3) | -16.5% (-27.6 to -4.8)* | 5317.5 (4017.1 to 7217.5) | -13.4% (-24.8 to -1.4)* | 80.0 (60.4 to 108.6) | -16.7% (-27.7 to -5.0)* |
| Congenital heart anomalies | 261.2 (216.6 to 308.2) | -17.9% (-24.6 to -9.8)* | 3.9 (3.2 to 4.6) | -21.8% (-28.1 to -14.1)* | 21 634.4 (17 770.6 to 25 604.8) | -18.9% (-25.5 to -10.8)* | 321.7 (263.6 to 381.4) | -22.4% (-28.7 to -14.6)* |
| Orofacial clefts | 3.8 (1.5 to 8.8) | -40.0% (-54.5 to -22.5)* | 0.1 (0.0 to 0.1) | -41.9% (-55.9 to -25.1)* | 331.3 (130.1 to 770.5) | -40.0% (-54.5 to -22.7)* | 5.0 (2.0 to 11.7) | -41.9% (-56.0 to -25.2)* |
| Down syndrome | 26.1 (21.3 to 35.1) | 3.1% (-7.4 to 17.4) | 0.4 (0.3 to 0.5) | -5.2% (-14.2 to 7.0) | 1906.1 (1481.7 to 2707.9) | -1.4% (-11.5 to 13.9) | 27.7 (21.3 to 39.8) | -7.3% (-16.7 to 7.1) |
| Other chromosomal abnormalities | 17.9 (12.0 to 26.3) | 4.6% (-6.3 to 18.2) | 0.3 (0.2 to 0.4) | 0.3% (-10.1 to 13.2) | 1507.9 (1012.2 to 2233.3) | 3.9% (-6.9 to 17.4) | 22.6 (15.1 to 33.5) | 0.0% (-10.4 to 13.0) |
| Congenital musculoskeletal and limb anomalies | 11.0 (8.6 to 14.0) | -8.7% (-17.3 to 0.0) | 0.2 (0.1 to 0.2) | -12.8% (-20.9 to -4.5)* | 912.2 (708.9 to 1172.9) | -9.8% (-18.2 to -1.0)* | 13.6 (10.6 to 17.5) | -13.3% (-21.5 to -4.9)* |
| Urogenital congenital anomalies | 14.1 (10.3 to 16.9) | -2.5% (-11.8 to 9.2) | 0.2 (0.1 to 0.2) | -8.5% (-17.1 to 2.1) | 1105.8 (781.3 to 1347.8) | -5.5% (-14.6 to 6.3) | 16.4 (11.5 to 20.0) | -9.7% (-18.3 to 1.3) |
| Digestive congenital anomalies | 50.8 (37.7 to 71.8) | -16.2% (-27.1 to -6.4)* | 0.8 (0.6 to 1.1) | -19.3% (-29.8 to -9.8)* | 4398.7 (3253.9 to 6229.0) | -16.5% (-27.3 to -6.7)* | 66.3 (49.0 to 93.9) | -19.4% (-29.9 to -9.9)* |
| Other congenital anomalies | 138.3 (102.3 to 175.6) | -12.4% (-20.1 to -0.5)* | 2.1 (1.5 to 2.6) | -15.9% (-23.3 to -4.5)* | 11 746.6 (8613.3 to 14 951.0) | -13.0% (-20.7 to -1.1)* | 176.1 (128.8 to 224.2) | -16.3% (-23.7 to -4.8)* |
| Urinary diseases and male infertility | 271.2 (263.9 to 282.2) | 39.6% (34.9 to 43.4)* | 3.6 (3.5 to 3.7) | 5.7% (2.2 to 8.5)* | 6255.2 (6044.8 to 6542.1) | 20.8% (15.5 to 24.9)* | 81.1 (78.3 to 84.8) | -0.7% (-5.1 to 2.7) |
| Urinary tract infections | 206.4 (197.9 to 223.2) | 48.3% (42.9 to 53.5)* | 2.7 (2.6 to 3.0) | 10.9% (7.2 to 14.5)* | 4522.3 (4285.2 to 5016.3) | 31.4% (24.4 to 38.8)* | 58.4 (55.2 to 65.0) | 7.2% (1.7 to 13.0)* |
| Urolithiasis | 12.3 (10.5 to 15.7) | 30.4% (19.0 to 49.4)* | 0.2 (0.1 to 0.2) | -1.2% (-9.7 to 12.9) | 255.1 (216.0 to 323.5) | 19.6% (9.7 to 36.9)* | 3.2 (2.7 to 4.0) | -5.9% (-13.6 to 7.7) |
| Other urinary diseases | 52.5 (42.3 to 58.0) | 15.0% (8.0 to 25.5)* | 0.7 (0.6 to 0.8) | -9.9% (-15.3 to -2.2)* | 1477.8 (1172.2 to 1660.2) | -3.0% (-9.6 to 6.4) | 19.4 (15.4 to 21.9) | -18.2% (-23.3 to -10.6)* |
| Gynaecological diseases | 8.2 (7.4 to 8.7) | 19.1% (5.1 to 30.0)* | 0.1 (0.1 to 0.1) | -2.6% (-13.6 to 6.0) | 292.9 (272.6 to 318.7) | 9.2% (-2.8 to 20.6) | 3.7 (3.4 to 4.0) | -6.0% (-15.4 to 3.6) |
| Uterine fibroids | 2.4 (1.6 to 3.0) | 33.3% (6.7 to 54.6)* | 0.0 (0.0 to 0.0) | 8.1% (-14.9 to 24.7) | 74.2 (52.7 to 95.5) | 13.0% (-4.2 to 31.6) | 0.9 (0.6 to 1.2) | -4.8% (-20.0 to 10.5) |
| Polycystic ovarian syndrome | 0.0 (0.0 to 0.0) | 12.9% (-12.8 to 50.4) | 0.0 (0.0 to 0.0) | 1.0% (-22.5 to 34.8) | 0.7 (0.1 to 1.5) | 10.1% (-15.8 to 51.2) | 0.0 (0.0 to 0.0) | -0.1% (-24.3 to 37.2) |
| Endometriosis | 0.2 (0.1 to 0.2) | 11.8% (-12.4 to 45.5) | 0.0 (0.0 to 0.0) | -3.2% (-23.8 to 25.5) | 7.7 (3.2 to 12.0) | 10.4% (-12.9 to 41.7) | 0.1 (0.0 to 0.1) | -3.2% (-23.2 to 24.3) |
| Genital prolapse | 0.6 (0.3 to 0.9) | 0.6% (-15.4 to 16.1) | 0.0 (0.0 to 0.0) | -24.1% (-36.0 to -13.0)* | 14.5 (6.8 to 20.1) | -4.4% (-18.4 to 10.4) | 0.2 (0.1 to 0.2) | -24.0% (-35.2 to -11.9)* |
| Other gynaecological diseases | 5.0 (4.1 to 5.6) | 16.0% (4.1 to 27.9)* | 0.1 (0.1 to 0.1) | -3.6% (-12.2 to 5.9) | 195.8 (163.0 to 228.9) | 8.9% (-2.9 to 20.6) | 2.5 (2.1 to 2.9) | -4.8% (-14.2 to 5.1) |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|---|--|--|---|---|---|--|--|---|
| | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 |
| (Continued from previous page) | | | | | | | | |
| Haemoglobinopathies and haemolytic anaemias | 104.6 (82.0 to 132.2) | 5.8% (-1.4 to 13.4) | 1.4 (1.1 to 1.8) | -11.3% (-17.6 to -4.8)* | 4831.6 (3643.1 to 6268.9) | -1.8% (-13.1 to 9.4) | 66.6 (50.0 to 86.2) | -11.1% (-21.6 to -0.5)* |
| Thalassaemias | 7.2 (6.0 to 8.4) | -23.7% (-32.6 to -12.7)* | 0.1 (0.1 to 0.1) | -27.9% (-36.5 to -17.2)* | 564.7 (474.8 to 667.6) | -24.6% (-33.9 to -13.2)* | 8.2 (6.9 to 9.7) | -28.6% (-37.6 to -17.6)* |
| Sickle cell disorders | 38.4 (24.0 to 54.8) | 3.7% (-11.6 to 17.7) | 0.5 (0.3 to 0.8) | -3.1% (-17.6 to 10.3) | 2796.4 (1747.3 to 3913.6) | 2.1% (-13.7 to 17.3) | 39.7 (24.8 to 55.3) | -3.9% (-19.1 to 11.0) |
| G6PD deficiency | 16.7 (12.1 to 22.5) | 11.8% (4.7 to 19.6)* | 0.2 (0.2 to 0.3) | -7.1% (-12.1 to -1.0)* | 692.6 (522.0 to 896.1) | 4.4% (-2.5 to 12.3) | 8.8 (6.7 to 11.4) | -9.6% (-15.0 to -3.3)* |
| Other haemoglobinopathies and haemolytic anaemias | 42.2 (35.1 to 49.2) | 13.0% (9.3 to 16.5)* | 0.6 (0.5 to 0.6) | -16.1% (-18.7 to -13.4)* | 777.8 (634.5 to 917.2) | 1.3% (-2.2 to 4.8) | 9.9 (8.1 to 11.7) | -19.9% (-22.3 to -17.4)* |
| Endocrine, metabolic, blood, and immune disorders | 144.5 (115.1 to 152.3) | 28.2% (19.7 to 33.3)* | 1.9 (1.5 to 2.0) | 0.8% (-5.0 to 4.4) | 4506.4 (3762.3 to 4919.9) | 10.4% (2.7 to 16.9)* | 59.7 (50.0 to 65.5) | -5.5% (-11.2 to -0.2)* |
| Sudden infant death syndrome | 40.0 (18.0 to 77.0) | -17.3% (-28.6 to -1.4)* | 0.6 (0.3 to 1.2) | -20.2% (-31.2 to -4.9)* | 3494.3 (1570.1 to 6734.0) | -17.3% (-28.6 to -1.4)* | 52.7 (23.7 to 101.5) | -20.2% (-31.2 to -4.9)* |
| Injuries | 4484.7 (4332.0 to 4585.6) | 2.3% (0.5 to 4.0)* | 57.9 (55.9 to 59.2) | -13.7% (-15.1 to -12.2)* | 195 231.1 (188 807.7 to 199 825.5) | -6.4% (-7.8 to -4.8)* | 2548.3 (2461.9 to 2609.6) | -16.9% (-18.2 to -15.3)* |
| Transport injuries | 1335.0 (1289.1 to 1369.5) | -3.1% (-6.0 to -0.6)* | 17.0 (16.4 to 17.4) | -17.0% (-19.5 to -14.9)* | 61 937.8 (60 031.2 to 63 736.5) | -9.6% (-11.8 to -7.3)* | 800.5 (775.9 to 823.3) | -19.5% (-21.4 to -17.5)* |
| Road injuries | 1243.1 (1191.9 to 1276.9) | -3.2% (-6.3 to -0.5)* | 15.8 (15.2 to 16.3) | -17.1% (-19.7 to -14.9)* | 57 638.4 (55 500.8 to 59 369.2) | -9.7% (-12.0 to -7.3)* | 745.0 (718.1 to 767.4) | -19.6% (-21.6 to -17.5)* |
| Pedestrian road injuries | 486.2 (459.7 to 535.0) | -6.4% (-11.7 to -2.1)* | 6.2 (5.9 to 6.8) | -21.4% (-25.5 to -17.9)* | 20 850.8 (19 596.0 to 23 164.4) | -14.8% (-18.7 to -11.0)* | 270.4 (253.9 to 300.8) | -25.1% (-28.3 to -21.9)* |
| Cyclist road injuries | 68.9 (59.2 to 76.2) | 9.1% (1.8 to 16.4)* | 0.9 (0.7 to 1.0) | -8.8% (-14.8 to -2.5)* | 2853.5 (2471.6 to 3209.0) | 1.0% (-5.7 to 8.3) | 36.3 (31.5 to 41.0) | -11.8% (-17.8 to -5.3)* |
| Motorcyclist road injuries | 225.7 (196.1 to 238.6) | -0.6% (-8.9 to 5.2) | 2.9 (2.5 to 3.0) | -12.4% (-19.5 to -7.3)* | 11 416.3 (9969.6 to 12 098.0) | -5.7% (-12.5 to -0.5)* | 146.2 (127.5 to 154.9) | -14.8% (-20.7 to -10.1)* |
| Motor vehicle road injuries | 451.1 (423.4 to 472.9) | -2.5% (-6.2 to 1.3) | 5.8 (5.4 to 6.0) | -15.6% (-18.6 to -12.2)* | 22 004.1 (20 639.8 to 23 130.9) | -7.8% (-10.4 to -3.0)* | 285.3 (267.6 to 299.7) | -17.2% (-19.6 to -12.8)* |
| Other road injuries | 11.2 (9.9 to 12.8) | -5.5% (-11.0 to 16.1) | 0.1 (0.1 to 0.2) | -19.4% (-24.1 to -1.3)* | 513.8 (454.1 to 583.4) | -11.7% (-17.3 to 10.6) | 6.7 (5.9 to 7.6) | -21.4% (-26.5 to -1.7)* |
| Other transport injuries | 91.9 (84.5 to 107.2) | -1.5% (-6.2 to 3.7) | 1.2 (1.1 to 1.4) | -15.5% (-19.5 to -10.9)* | 4299.4 (3919.6 to 5048.3) | -7.8% (-12.6 to -2.4)* | 55.4 (50.5 to 65.0) | -17.9% (-22.2 to -13.2)* |
| Unintentional injuries | 1804.9 (1695.7 to 1872.0) | 2.9% (0.5 to 6.0)* | 23.8 (22.4 to 24.7) | -15.3% (-17.3 to -12.8)* | 69 430.5 (64 685.1 to 72 366.8) | -12.8% (-15.0 to -9.6)* | 928.8 (865.6 to 969.3) | -23.0% (-25.0 to -20.0)* |
| Falls | 695.8 (644.9 to 741.7) | 27.4% (21.2 to 35.6)* | 9.2 (8.5 to 9.8) | -2.8% (-7.4 to 3.4) | 16 688.1 (15 101.9 to 17 636.8) | 10.1% (4.8 to 17.2)* | 216.6 (196.4 to 228.6) | -8.4% (-12.7 to -2.5)* |
| Drowning | 295.2 (284.5 to 306.2) | -17.2% (-19.8 to -14.1)* | 4.0 (3.8 to 4.1) | -27.3% (-29.6 to -24.5)* | 16 563.3 (15 784.2 to 17 350.0) | -26.1% (-29.0 to -22.4)* | 228.3 (217.2 to 239.7) | -32.8% (-35.5 to -29.3)* |
| Fire heat and hot substances | 120.6 (101.6 to 129.4) | -7.9% (-10.9 to -1.2)* | 1.6 (1.3 to 1.7) | -22.9% (-25.4 to -17.3)* | 5286.3 (4308.9 to 5836.4) | -16.5% (-21.0 to -7.3)* | 71.0 (57.8 to 78.6) | -25.5% (-29.6 to -17.1)* |
| Poisonings | 72.4 (52.7 to 79.4) | -6.8% (-16.1 to 2.9) | 0.9 (0.7 to 1.0) | -20.8% (-28.4 to -12.5)* | 3321.7 (2454.1 to 3669.2) | -14.6% (-22.7 to -3.8)* | 44.1 (32.7 to 48.8) | -23.9% (-31.0 to -14.1)* |
| Poisoning by carbon monoxide | 35.5 (25.7 to 38.8) | -12.5% (-22.4 to -5.0)* | 0.5 (0.3 to 0.5) | -26.6% (-34.8 to -20.3)* | 1462.4 (1073.0 to 1613.6) | -19.1% (-27.2 to -11.8)* | 18.9 (13.8 to 20.9) | -29.0% (-36.2 to -22.4)* |
| Poisoning by other means | 36.9 (26.8 to 41.0) | -0.5% (-10.1 to 11.9) | 0.5 (0.4 to 0.5) | -14.4% (-22.4 to -3.9)* | 1859.3 (1385.8 to 2072.9) | -10.7% (-19.6 to 3.3) | 25.2 (19.0 to 28.1) | -19.6% (-27.7 to -6.8)* |

(Table 1 continues on next page)

| | All-age deaths (thousands) | | Age-standardised death rate (per 100 000) | | All-age YLLs (thousands) | | Age-standardised YLL rate (per 100 000) | |
|---|--------------------------------------|-------------------------------|---|----------------------------------|--|-------------------------------|---|----------------------------------|
| | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 |
| (Continued from previous page) | | | | | | | | |
| Exposure to mechanical forces | 136.5 (117.6 to 143.2) | -6.7% (-9.8 to -3.7)* | 1.8 (1.5 to 1.8) | -20.3% (-22.9 to -17.8)* | 6385.5 (5500.4 to 6710.8) | -13.8% (-16.6 to -10.8)* | 84.0 (72.3 to 88.3) | -23.0% (-25.5 to -20.3)* |
| Unintentional firearm injuries | 22.6 (21.1 to 25.8) | -2.9% (-7.5 to 2.8) | 0.3 (0.3 to 0.3) | -16.4% (-20.3 to -11.5)* | 1094.5 (1013.5 to 1275.4) | -7.4% (-12.2 to -1.3)* | 14.4 (13.3 to 16.9) | -16.5% (-20.9 to -11.1)* |
| Other exposure to mechanical forces | 113.9 (94.7 to 120.8) | -7.4% (-10.6 to -4.1)* | 1.5 (1.2 to 1.6) | -21.0% (-23.7 to -18.3)* | 5291.0 (4401.1 to 5626.1) | -15.0% (-18.0 to -11.7)* | 69.6 (57.8 to 74.0) | -24.3% (-26.9 to -21.2)* |
| Adverse effects of medical treatment | 121.6 (103.6 to 137.6) | 16.6% (12.0 to 20.9)* | 1.6 (1.4 to 1.8) | -6.2% (-10.0 to -2.5)* | 4363.9 (3619.9 to 5234.0) | 4.0% (-1.2 to 11.0) | 58.1 (48.0 to 70.7) | -9.5% (-13.9 to -3.6)* |
| Animal contact | 81.1 (44.9 to 94.0) | -1.4% (-6.8 to 6.2) | 1.1 (0.6 to 1.2) | -16.0% (-20.5 to -9.6)* | 3911.9 (2167.6 to 4585.6) | -9.5% (-15.8 to 0.2) | 52.4 (29.0 to 61.8) | -19.2% (-25.2 to -10.2)* |
| Venomous animal contact | 70.9 (37.0 to 83.8) | -1.3% (-7.5 to 6.2) | 0.9 (0.5 to 1.1) | -16.0% (-21.0 to -9.7)* | 3407.7 (1758.4 to 4087.5) | -9.7% (-16.4 to -0.7)* | 45.5 (23.4 to 54.9) | -19.4% (-25.8 to -11.3)* |
| Non-venomous animal contact | 10.1 (7.1 to 14.4) | -1.6% (-15.3 to 10.2) | 0.1 (0.1 to 0.2) | -16.1% (-27.4 to -6.2)* | 504.2 (335.8 to 750.1) | -7.9% (-26.1 to 6.5) | 6.9 (4.5 to 10.3) | -17.2% (-33.6 to -4.3)* |
| Foreign body | 124.1 (119.3 to 130.0) | 1.7% (-1.9 to 4.8) | 1.7 (1.6 to 1.8) | -14.1% (-17.0 to -11.6)* | 5907.0 (5566.3 to 6301.2) | -12.4% (-16.4 to -8.3)* | 83.3 (78.3 to 88.9) | -20.1% (-23.8 to -16.3)* |
| Pulmonary aspiration and foreign body in airway | 115.7 (111.4 to 121.3) | 1.9% (-1.9 to 5.0) | 1.6 (1.5 to 1.7) | -13.9% (-17.0 to -11.4)* | 5526.1 (5212.6 to 5910.0) | -12.2% (-16.6 to -8.0)* | 78.1 (73.5 to 83.7) | -19.9% (-23.8 to -16.0)* |
| Foreign body in other body part | 8.4 (7.5 to 10.3) | -0.5% (-6.9 to 7.1) | 0.1 (0.1 to 0.1) | -15.8% (-20.8 to -10.0)* | 381.0 (326.2 to 474.4) | -14.4% (-21.1 to -6.2)* | 5.2 (4.4 to 6.5) | -23.3% (-29.2 to -16.1)* |
| Environmental heat and cold exposure | 53.3 (36.8 to 59.2) | -13.2% (-22.4 to -8.4)* | 0.7 (0.5 to 0.8) | -29.4% (-37.1 to -25.4)* | 1845.6 (1246.6 to 2066.2) | -21.4% (-28.8 to -17.5)* | 23.7 (15.8 to 26.7) | -32.7% (-39.5 to -29.1)* |
| Exposure to forces of nature | 9.6 (8.7 to 11.0) | -38.0% (-43.9 to -28.9)* | 0.1 (0.1 to 0.1) | -45.8% (-50.8 to -37.9)* | 477.6 (438.4 to 544.3) | -45.0% (-49.4 to -37.3)* | 6.3 (5.8 to 7.2) | -50.2% (-54.2 to -43.2)* |
| Other unintentional injuries | 94.7 (91.9 to 98.3) | -14.5% (-16.7 to -12.1)* | 1.2 (1.2 to 1.3) | -25.8% (-27.6 to -23.8)* | 4679.6 (4519.4 to 4888.2) | -20.7% (-22.9 to -18.1)* | 60.9 (58.8 to 63.7) | -28.9% (-30.9 to -26.6)* |
| Self-harm and interpersonal violence | 1344.8 (1283.1 to 1380.4) | 7.3% (4.6 to 9.7)* | 17.1 (16.3 to 17.5) | -7.6% (-9.9 to -5.5)* | 63 862.9 (61 029.9 to 65 755.7) | 5.4% (2.8 to 7.7)* | 819.0 (782.2 to 843.4) | -5.7% (-7.9 to -3.7)* |
| Self-harm | 793.8 (743.5 to 819.7) | 1.1% (-2.6 to 3.7) | 10.0 (9.4 to 10.3) | -14.8% (-18.0 to -12.6)* | 33 577.2 (31 449.3 to 34 719.1) | -3.4% (-7.0 to -0.9)* | 423.6 (396.9 to 438.2) | -15.1% (-18.4 to -12.9)* |
| Self-harm by firearm | 63.8 (54.6 to 78.6) | 6.8% (2.3 to 10.8)* | 0.8 (0.7 to 1.0) | -10.3% (-13.9 to -7.2)* | 2653.6 (2241.9 to 3288.1) | 0.9% (-3.5 to 5.5) | 33.5 (28.2 to 41.6) | -11.5% (-15.2 to -7.6)* |
| Self-harm by other specified means | 730.0 (678.5 to 754.9) | 0.6% (-3.2 to 3.4) | 9.2 (8.5 to 9.5) | -15.2% (-18.4 to -12.8)* | 30 923.6 (28 832.4 to 32 098.2) | -3.7% (-7.5 to -1.1)* | 390.1 (363.6 to 405.1) | -15.4% (-18.8 to -13.1)* |
| Interpersonal violence | 405.3 (365.2 to 431.7) | 0.5% (-2.0 to 3.2) | 5.2 (4.7 to 5.5) | -11.1% (-13.3 to -8.7)* | 21 439.8 (19 275.8 to 22 799.8) | -1.6% (-4.4 to 1.3) | 276.8 (248.4 to 294.2) | -10.9% (-13.4 to -8.2)* |
| Assault by firearm | 174.4 (147.9 to 188.9) | 7.5% (4.3 to 10.8)* | 2.2 (1.9 to 2.4) | -3.6% (-6.5 to -0.5)* | 9541.2 (8106.2 to 10 291.7) | 5.4% (2.1 to 9.0)* | 122.9 (104.3 to 132.4) | -3.7% (-6.7 to -0.4)* |
| Assault by sharp object | 91.4 (74.4 to 111.2) | -11.5% (-15.3 to -6.0)* | 1.2 (0.9 to 1.4) | -22.3% (-25.6 to -17.6)* | 4634.5 (3747.0 to 5648.9) | -13.9% (-17.6 to -8.5)* | 59.2 (47.8 to 72.1) | -22.6% (-25.9 to -17.8)* |
| Assault by other means | 139.5 (123.6 to 164.4) | 1.3% (-3.4 to 5.6) | 1.8 (1.6 to 2.1) | -11.5% (-15.4 to -7.6)* | 7264.1 (6400.8 to 8583.0) | -1.3% (-5.4 to 3.6) | 94.7 (83.3 to 111.5) | -11.2% (-14.9 to -6.8)* |
| Conflict and terrorism | 129.7 (118.1 to 143.2) | 118.0% (88.8 to 148.6)* | 1.7 (1.6 to 1.9) | 98.4% (72.4 to 126.1)* | 7966.6 (7244.5 to 8855.9) | 113.5% (84.5 to 146.8)* | 107.3 (97.6 to 119.1) | 97.9% (71.0 to 128.8)* |
| Executions and police conflict | 16.0 (15.7 to 16.3) | 203.9% (186.9 to 220.9)* | 0.2 (0.2 to 0.2) | 172.4% (156.8 to 187.6)* | 879.3 (862.3 to 898.1) | 202.1% (184.8 to 219.8)* | 11.4 (11.2 to 11.7) | 176.4% (160.5 to 192.9)* |

Data in parentheses are 95% uncertainty intervals. G6PD=glucose-6-phosphate dehydrogenase. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. H influenzae=Haemophilus influenzae. NASH=non-alcoholic steatohepatitis. YLL=years of life lost. *Percentage changes that are statistically significant.

Table 1: Global death and YLL numbers, age-standardised rates per 100 000, and percentage change between 2007 and 2017 for both sexes combined for all GBD causes and Levels 1 through 4 of the cause hierarchy

age-sex-cause death rate using GBD estimates from all national locations across all years from 1980 to 2017 (appendix 1 section 7). Expected cause-specific death rates were scaled to the expected all-cause death rate to ensure internal consistency. We then computed the number of YLLs and deaths expected for each age-sex-location-year based on SDI alone and compared these estimates to observed rates. Additional details of the development and calculation of SDI for GBD 2017 are described in appendix 1 (section 5).

Role of the funding source

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

Results

Global causes of death

Mortality estimates by cause for the years 1990, 2007, and 2017 are available by age and sex through the GBD results tool and for each year in the GBD estimation period 1980–2017 through the online data visualisation tool. All reported rates are age-standardised.

In 2017, at the broadest level of cause of death classification in the GBD cause list (Level 1), CMNN causes accounted for 18.6% (95% UI 17.9–19.6) of total deaths or 10.4 million (10.0–11.0) deaths in 2017, while non-communicable causes (NCDs) accounted for 73.4% (72.5–74.1) or 41.1 million (40.5–41.5) deaths, and injuries accounted for 8.0% (7.7–8.2) of deaths or 4.48 million (4.33–4.59) deaths (table 1). Of the 1.65 billion (1.62–1.67) global YLLs in 2017, 35.1% (34.2–36.2) were from CMNN causes, 53.0% (52.2–53.8) were from NCDs, and the remaining 11.9% (11.5–12.1) were from injuries. Both the number of deaths and death rates from CMNN causes decreased from 2007 to 2017, by 22.2% (20.0–24.0) in terms of total deaths and by 31.8% (30.1–33.3) in terms of mortality rate. Decreases in the number and rate of YLLs from CMNN causes were similar in magnitude (30.4% [28.2–32.4] decrease in YLLs; 35.4% [33.4–37.3] decrease in YLL rate) over the same time period. By contrast, total deaths from NCD causes increased between 2007 and 2017 by 22.7% (21.5–23.9) and total YLLs from NCD causes increased by 13.6% (12.2–14.9), representing an additional 7.61 million (7.20–8.01) deaths and 105 million (94.3–114.0) YLLs estimated in 2017. Rates of both deaths and YLLs from NCD causes decreased over the same time period, by 7.9% (7.0–8.8) to 536.1 deaths (528.4–542.2) per 100 000, with a 9.6% (8.6–10.7) decrease in the YLL rate to 11100 YLLs (10900–11300) per 100 000 in 2017. Total deaths from injuries varied little between 2007 and 2017, with an increase of 2.3% (0.5–4.0) to 4.48 million (4.33–4.59) deaths, while death rates from injury decreased by 13.7% (12.2–15.1) to 57.9 deaths

(55.9–59.2) per 100 000 in 2017. Decreases in the number of YLLs (by 6.4% [4.8–7.8] to 195 million [189–200] YLLs in 2017) and YLL rate (by 16.9% [15.3–18.2] to 2550 [2460–2610] YLLs per 100 000 in 2017) for injuries were estimated during the same period.

Communicable, maternal, neonatal, and nutritional diseases

The overall decrease in communicable causes of death included reductions in some of the largest contributors to global mortality, including HIV/AIDS, tuberculosis, diarrhoeal diseases, and malaria (table 1). The peak in HIV/AIDS mortality occurred in 2006 with 1.95 million deaths (95% UI 1.87–2.04) and a rate of 28.8 deaths (27.7–30.1) per 100 000, but between 2007 and 2017, total mortality from HIV/AIDS decreased from 1.92 million (1.84–2.00) deaths to 0.954 million (0.907–1.01) deaths with a commensurate decrease (56.5% [54.7–58.0]) in the mortality rate from 27.9 deaths (26.8–29.1) per 100 000 in 2007 to 12.1 deaths (11.5–12.9) per 100 000 in 2017. Although tuberculosis caused an estimated 1.18 million (1.13–1.25) deaths in 2017, this was nonetheless a decrease of 14.9% (10.3–18.2) from levels in 2007, when tuberculosis caused 1.39 million (1.34–1.46) deaths. Drug-susceptible tuberculosis deaths were the largest component of tuberculosis deaths in 2017 (88.2% [81.4–93.3]) and decreased the most since 2007 (15.5% [8.6–22.3]) in comparison with other tuberculosis sub-causes. All HIV/AIDS and tuberculosis co-infections also decreased, with declines occurring for deaths from HIV/AIDS and drug-resistant tuberculosis co-infection (8.3% [–26.8 to 14.7]), HIV/AIDS and multidrug-resistant tuberculosis co-infection (52.2% [33.2–66.4]), and HIV/AIDS and drug-susceptible tuberculosis co-infection (55.4% [51.6–58.4]). The total number of deaths from diarrhoeal diseases decreased by 16.6% (6.7–25.3) between 2007 and 2017, from 1.88 million (1.53–2.47) deaths in 2007 to 1.57 million (1.18–2.19) deaths in 2017. There was a parallel decrease in the death rate (30.2% [22.7–36.1]) from diarrhoeal diseases, from 31.0 deaths (25.0–40.9) per 100 000 in 2007 to 21.6 deaths (16.4–29.7) per 100 000 in 2017. There were 620 000 deaths (440 000–840 000) from malaria in 2017, a decrease of 30.8% (20.8–39.4) from 2007 when 896 000 deaths (664 000–1 180 000) were estimated. Deaths due to measles decreased by 57.0% (51.9–61.9) from 222 000 deaths (82 300–457 000) in 2007 to 95 300 (34 500–205 000) in 2017. Invasive non-typhoidal salmonella deaths were estimated to have decreased from 71 900 deaths (42 200–116 000) in 2007 to 59 100 deaths (33 300–98 100) in 2017. A notable exception to the estimated improvements for communicable diseases occurred for dengue, where deaths increased by 65.5% (21.7–99.7) from 24 500 (11 500–29 600) in 2007 to 40 500 (17 600–49 800) in 2017, with a similar increase in mortality rate (40.7% [3.6–69.7], from 0.4 deaths [0.2–0.5] per 100 000 in 2007 to 0.5 deaths [0.2–0.7] per 100 000 in 2017).

At Level 2 of the GBD cause hierarchy, there were 1.98 million (95% UI 1.89–2.06) deaths from maternal

For the online results tool see <http://ghdx.healthdata.org/gbd-results-tool>

and neonatal disorders globally in 2017, and 90.2% (89.4–90.9) of these deaths were from neonatal disorders (table 1). Deaths from neonatal disorders decreased by 24.1% (20.6–27.2), from 2.35 million (2.27–2.44) deaths in 2007 to 1.78 million (1.70–1.86) in 2017. A 26.2% (22.7–29.1) decrease in death rates for neonatal disorders was also estimated, from 36.7 deaths (35.3–38.0) per 100 000 in 2007 to 27.1 (25.8–28.3) per 100 000 in 2017. Deaths from maternal disorders decreased by 24.0% (19.5–28.4), from 255 000 deaths (241 000–268 000) in 2007 to 194 000 deaths (180 000–210 000) in 2017. The mortality rate for maternal disorders decreased by 30.7% (26.6–34.8), from 3.6 deaths (3.4–3.8) per 100 000 in 2007 to 2.5 (2.3–2.7) per 100 000 in 2017.

There were 270 000 deaths (95% UI 249 000–295 000) from nutritional deficiencies in 2017, representing 2.60% (2.37–2.86) of all deaths from CMNN causes in that year (table 1). Decreases in death rates from nutritional deficiencies followed a trajectory similar to that of maternal and neonatal disorders, with mortality rates from nutritional deficiencies decreasing by 33.6% (26.5–38.1), from 5.8 deaths (5.4–6.2) per 100 000 in 2007 to 3.8 (3.5–4.2) per 100 000 in 2017.

Non-communicable diseases

At Level 2 of the GBD hierarchy, the largest numbers of deaths from NCDs were estimated for cardiovascular diseases (17.8 million [95% UI 17.5–18.0] deaths), followed by neoplasms (9.56 million [9.40–9.69] deaths) and chronic respiratory diseases (3.91 million [3.79–4.04] deaths; table 1). Overall, deaths from NCDs increased globally, from 33.5 million (33.1–33.8) in 2007 to 41.1 million (40.5–41.5) in 2017, while the death rate decreased (from 582.1 deaths [575.1–587.8] per 100 000 in 2007 to 536.1 deaths [528.4–542.2] per 100 000 in 2017). Total deaths from NCDs decreased significantly for only two Level 3 causes: sudden infant death syndrome (17.3% [1.4–28.6]) and congenital anomalies (14.3% [10.1–21.1]). During the past decade the estimated number of deaths from neurological disorders increased by 42.1% (40.2–43.9), from 2.18 million (2.14–2.20) deaths in 2007 to 3.09 million (3.04–3.14) deaths in 2017; although the death rate increased, this change was not significant (0.1% [–1.2 to 1.3], from 43.0 deaths [42.3–43.4] per 100 000 in 2007 to 43.1 deaths [42.3–43.7] per 100 000 in 2017). Among neurological disorders, the greatest increase between 2007 and 2017 occurred for deaths from Alzheimer's disease and other dementias (an increase of 46.2% [43.9–48.0], from 1.72 million [1.70–1.74] deaths in 2007 to 2.51 million [2.47–2.55] in 2017; and from 35.2 deaths [34.7–35.5] per 100 000 in 2007 to 35.4 [34.8–35.9] per 100 000 in 2017).

At a global level, total deaths from cardiovascular diseases increased by 21.1% (95% UI 19.7–22.6) between 2007 and 2017 but death rates decreased from 259.9 deaths (257.1–263.7) per 100 000 in 2007 to 233.1 (229.7–236.4)

per 100 000 in 2017 (table 1). In combination, ischaemic heart disease and stroke—at Level 3 of the cause hierarchy—accounted for 84.9% (84.3–86.3) of cardiovascular disease deaths in 2017. Deaths from both these causes increased between 2007 and 2017, from 7.30 million (7.22–7.46) deaths to 8.93 million (8.79–9.14) deaths for ischaemic heart disease, and from 5.29 million (5.22–5.40) deaths to 6.17 million (6.04–6.33) deaths for stroke. The largest decline in mortality rates among cardiovascular diseases during the same decade occurred for rheumatic heart disease, which decreased by 21.3% (17.8–25.2) between 2007 and 2017, from 4.7 deaths (4.4–5.0) per 100 000 to 3.7 deaths (3.4–3.9) per 100 000.

Neoplasms contributed to 23.3% (95% UI 23.0–23.5) of deaths from NCDs in 2017, with tracheal, bronchus, and lung cancer leading to the most deaths (1.88 million [1.84–1.92]), followed by colon and rectum cancer (896 000 [876 000–916 000]; table 1). Newly estimated for GBD 2017, liver cancer due to NASH caused 66 900 deaths (59 600–74 500) in 2017, representing an increase of 42.3% (38.0–47.6) from 2007. Globally, deaths from cancers increased by 25.4% (23.9–27.0) between 2007 and 2017, from 7.62 million (7.51–7.70) deaths in 2007 to 9.56 million (9.40–9.69) deaths in 2017. The largest increases occurred for other neoplasms, which includes myelodysplastic, myeloproliferative, and other haemopoietic neoplasms, benign and in-situ intestinal, cervical, and uterine neoplasms, and other benign and in-situ neoplasms (increase of 42.0% [35.6–51.7] to 103 000 deaths [80 200–122 000]), other pharynx cancer (increase of 40.4% [29.7–48.4] to 117 000 deaths [102 000–124 000]), and pancreatic cancer (increase of 39.9% [36.7–42.6] to 441 000 deaths [433 000–449 000]). Mortality rates for most types of cancer decreased in the decade 2007–17; the largest statistically significant decreases occurred for stomach cancer (decrease of 17.1% [15.1–18.8] to 11.0 deaths [10.8–11.2] per 100 000), Hodgkin lymphoma (decrease of 16.8% [14.0–19.8] to 0.4 deaths [0.4–0.5] per 100 000), and oesophageal cancer (decrease of 14.5% [12.0–16.9] to 5.5 deaths [5.3–5.6] per 100 000).

Several non-communicable causes were separately estimated for the first time in GBD 2017. Among these, diabetes mellitus resulted in 1.37 million (95% UI 1.34–1.40) deaths in 2017, of which 25.2% (23.0–27.3) were from type 1 diabetes (table 1). Total deaths from type 1 diabetes increased from 2007 to 2017 by 15.1% (10.5–19.0) and those from type 2 diabetes by 43.0% (40.4–45.8). During this time period, the mortality rate decreased by 11.0% (7.8–14.6) for type 1 diabetes and increased by 5.9% (4.1–8.0) for type 2 diabetes. Deaths from diabetes-related chronic kidney disease also increased over the past decade, rising from 62 800 deaths (51 100–76 200) in 2007 to 77 300 deaths (62 400–95 200) in 2017 for chronic kidney disease due to type 1 diabetes and from 248 000 deaths (219 000–282 000) in 2007 to 349 000 (307 000–396 000) in 2017 for chronic kidney disease due to type 2 diabetes. Among other newly

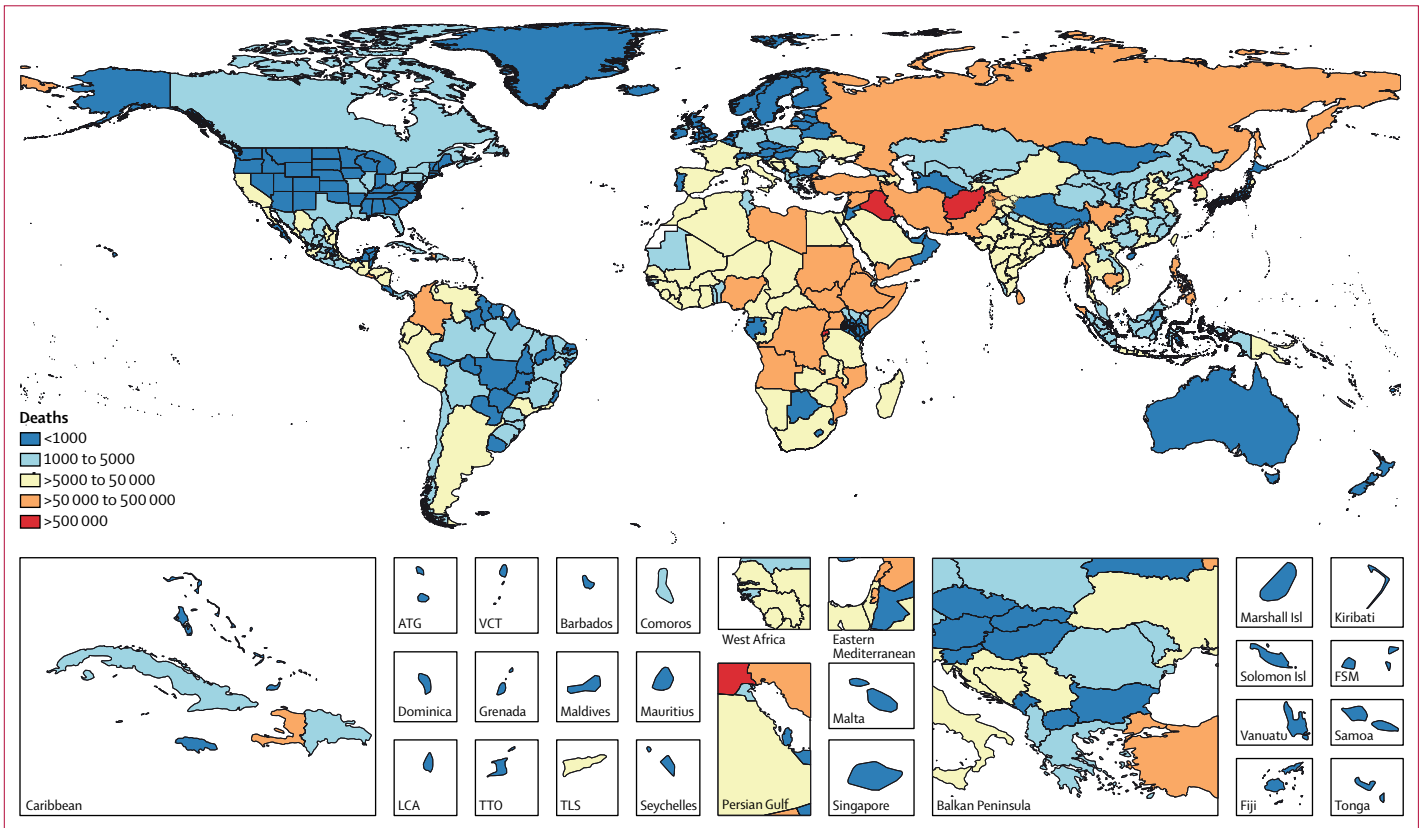


Figure 3: All-age deaths due to fatal discontinuities (violence, disasters, famine, and disease outbreak), for both sexes combined, 1980–2017

We have chosen to show this map in counts to capture the wide range of discontinuity-related deaths ranging from motor vehicle accidents with a smaller number of deaths to natural disasters and conflicts with a larger number of deaths. Deaths are coded to the location of residence for the deceased. Maps by each subtype—violence, disasters, famine, and disease outbreak—are provided in appendix 2. ATG=Antigua and Barbuda. FSM=Federated States of Micronesia. Isl=Islands. LCA=Saint Lucia. TLS=Timor-Leste. TTO=Trinidad and Tobago. VCT=Saint Vincent and the Grenadines.

estimated causes, subarachnoid haemorrhage was estimated to have caused 445 000 deaths (417 000–492 000) in 2017, representing 0·8% (0·7–0·9) of global deaths and 2·5% (2·3–2·8) of cardiovascular disease deaths in 2017; deaths from non-rheumatic valvular heart disease (145 000 [122 000–150 000]) represented 0·3% (0·2–0·3) of global deaths and 0·8% (0·7–0·9) of cardiovascular disease deaths in 2017. Deaths from substance use disorders increased between 2007 and 2017, rising from 284 000 deaths (268 000–289 000) to 352 000 deaths (334 000–363 000) globally; although not statistically significant, the death rate for these disorders increased by 2·0% (–1·0 to 5·0) during this period, rising from 4·3 deaths (4·0 to 4·3) per 100 000 to 4·3 (4·1 to 4·5) per 100 000 (table 1). The greatest number of deaths from drug use disorders were due to opioid use disorders, which resulted in 110 000 deaths (106 000–114 000) globally in 2017, comprising 65·7% (63·8–67·4) of global deaths from drug use disorders.

Injuries

At Level 3 of the cause hierarchy, most injury deaths were from road injuries, which caused 1·24 million (95% UI 1·19–1·28) deaths in 2017, representing 27·7%

(26·7–28·9) of all injury deaths in that year (table 1). 794 000 deaths (744 000–820 000) in 2017 were from self-harm, followed by 696 000 deaths (645 000–742 000) from falls, 405 000 deaths (365 000–432 000) from interpersonal violence, and 295 000 deaths (285 000–306 000) from drowning. Mortality rates in 2017 were highest among injury causes of death at Level 3 of the GBD hierarchy for road injuries (15·8 deaths [15·2–16·3] per 100 000), self-harm (10·0 deaths [9·4–10·3] per 100 000), and falls (9·2 deaths [8·5–9·8] per 100 000). Overall, from 2007 to 2017, there were 20·1 million (18·7–20·8) deaths from unintentional injuries, 15·1 million (14·8–15·4) deaths from transport injuries, and 14·4 million (13·7–14·7) deaths from self-harm and interpersonal violence. Poisoning by carbon monoxide, estimated for the first time for GBD 2017, caused 35 500 deaths (25 700–38 800) in 2017.

Since 1980, sudden changes in the expected number of deaths—described as fatal discontinuities in the GBD study—were found in several countries (figure 3). To emphasise the magnitude of these events, we describe total deaths rather than rates in this report. Figure 3 combines total deaths across disparate types of fatal discontinuity; appendix 2 separates these deaths by

| | All-age deaths (thousands) | | Under-5 deaths (thousands) | | Deaths at age 5-14 years (thousands) | | Deaths at age 15-49 years (thousands) | | Deaths at age 50-69 years (thousands) | | Deaths at age ≥70 years (thousands) | |
|---|---|------------------------------------|-------------------------------------|------------------------------------|--------------------------------------|------------------------------------|---------------------------------------|------------------------------------|---|------------------------------------|---|------------------------------------|
| | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 |
| All causes | 55 945.7 (55 356.4 to 56 516.7) | 9.3% (8.2 to 10.2)* | 5391.6 (5195.4 to 5612.9) | -31.4% (-33.8 to -28.7)* | 731.7 (720.0 to 744.1) | -21.9% (-23.2 to -20.5)* | 7614.0 (7496.5 to 7741.4) | -11.2% (-12.3 to -9.9)* | 14 998.6 (14 827.9 to 15 170.8) | 22.7% (21.2 to 24.0)* | 27 209.8 (26 976.2 to 27 441.9) | 25.9% (24.7 to 26.9)* |
| Communicable, maternal, neonatal, and nutritional diseases | 10 389.9 (10 004.0 to 10 975.9) | -22.2% (-24.0 to -20.0)* | 4366.5 (4193.1 to 4563.3) | -33.6% (-36.3 to -30.8)* | 352.2 (330.8 to 380.6) | -29.4% (-31.7 to -27.0)* | 1896.8 (1813.8 to 1992.6) | -33.2% (-34.8 to -31.5)* | 1463.3 (1377.8 to 1606.9) | -1.8% (-4.2 to 1.3) | 2311.0 (2113.6 to 2616.4) | 18.4% (15.0 to 22.7)* |
| HIV/AIDS and sexually transmitted infection | 1073.6 (983.3 to 1182.4) | -47.7% (-50.0 to -45.1)* | 187.8 (117.0 to 286.3) | -47.9% (-58.3 to -38.4)* | 46.2 (43.1 to 49.3) | -12.9% (-17.6 to -7.9)* | 679.6 (633.3 to 727.6) | -50.1% (-52.1 to -47.9)* | 144.8 (135.6 to 156.1) | -42.2% (-45.6 to -38.4)* | 15.2 (14.0 to 16.6) | -46.3% (-50.4 to -41.3)* |
| HIV/AIDS | 954.5 (907.3 to 1009.7) | -50.3% (-52.1 to -48.3)* | 77.5 (69.0 to 86.8) | -67.1% (-70.3 to -63.4)* | 44.8 (42.0 to 47.7) | -13.0% (-17.9 to -7.9)* | 676.1 (629.7 to 724.5) | -50.2% (-52.3 to -48.0)* | 142.6 (133.3 to 153.7) | -42.7% (-46.0 to -38.8)* | 13.5 (12.3 to 14.9) | -49.8% (-54.0 to -44.6)* |
| HIV/AIDS resulting in other diseases | 736.0 (659.5 to 817.7) | -48.7% (-51.1 to -45.9)* | 54.6 (46.0 to 64.9) | -64.5% (-68.8 to -59.2)* | 30.1 (26.3 to 35.0) | -11.3% (-17.4 to -4.4)* | 531.1 (470.1 to 596.1) | -49.8% (-52.6 to -46.9)* | 109.5 (97.1 to 124.8) | -35.9% (-40.3 to -30.2)* | 10.7 (9.3 to 12.3) | -38.0% (-43.7 to -30.3)* |
| Respiratory infections and tuberculosis | 3752.3 (3629.4 to 3889.3) | -8.0% (-10.3 to -5.5)* | 870.5 (803.3 to 941.4) | -36.7% (-40.6 to -32.4)* | 58.1 (52.1 to 64.1) | -27.4% (-31.5 to -23.3)* | 543.2 (520.8 to 570.8) | -18.2% (-20.7 to -15.2)* | 836.8 (805.0 to 868.5) | 7.8% (4.5 to 12.0)* | 1443.7 (1392.6 to 1503.7) | 21.9% (19.4 to 24.7)* |
| Tuberculosis | 1183.7 (1129.8 to 1245.3) | -14.9% (-18.2 to -10.3)* | 57.4 (51.3 to 63.6) | -39.8% (-44.5 to -34.2)* | 13.7 (12.2 to 15.5) | -38.4% (-42.7 to -33.8)* | 371.7 (353.1 to 392.2) | -23.4% (-26.5 to -19.8)* | 429.7 (410.6 to 452.7) | -5.2% (-9.6 to 0.9) | 311.2 (294.2 to 330.7) | -6.9% (-11.2 to -0.4)* |
| Drug-susceptible tuberculosis | 1044.1 (951.6 to 1129.2) | -15.5% (-22.3 to -8.6)* | 51.4 (45.3 to 57.6) | -40.5% (-46.0 to -34.1)* | 12.2 (10.7 to 13.9) | -39.0% (-44.2 to -33.5)* | 326.5 (297.0 to 353.9) | -23.8% (-29.9 to -18.1)* | 377.7 (342.6 to 409.5) | -6.0% (-14.3 to 2.4) | 276.4 (251.1 to 300.9) | -7.6% (-15.6 to 0.8) |
| Lower respiratory infections | 2558.6 (2442.2 to 2655.4) | -4.3% (-6.9 to -1.5)* | 808.9 (747.3 to 873.6) | -36.4% (-40.6 to -32.2)* | 43.9 (38.9 to 48.7) | -23.0% (-27.5 to -18.5)* | 170.5 (157.0 to 182.6) | -4.0% (-6.3 to -1.5)* | 405.8 (366.8 to 422.6) | 26.5% (23.2 to 29.7)* | 1129.4 (1078.5 to 1180.4) | 33.6% (31.2 to 36.1)* |
| Enteric infections | 1766.0 (1398.0 to 2386.0) | -17.2% (-24.6 to -8.2)* | 589.4 (528.3 to 653.6) | -39.1% (-46.1 to -31.0)* | 111.9 (83.6 to 151.3) | -27.9% (-32.7 to -21.7)* | 187.1 (135.4 to 278.7) | -14.4% (-20.0 to -5.5)* | 249.3 (158.0 to 413.5) | 2.8% (-5.3 to 16.8) | 628.3 (395.4 to 975.5) | 14.8% (4.3 to 30.7)* |
| Diarrhoeal diseases | 1569.6 (1176.0 to 2193.0) | -16.6% (-25.3 to -6.7)* | 533.8 (477.2 to 593.1) | -40.6% (-47.8 to -32.2)* | 44.5 (27.5 to 73.1) | -27.2% (-36.6 to -14.1)* | 128.2 (77.2 to 216.2) | -14.1% (-21.6 to -1.9)* | 239.1 (145.9 to 404.4) | 3.5% (-4.7 to 18.0) | 624.0 (390.4 to 972.3) | 15.0% (4.5 to 31.1)* |
| Neglected tropical diseases and malaria | 720.1 (530.7 to 938.8) | -29.0% (-37.3 to -19.3)* | 375.9 (250.3 to 527.8) | -39.2% (-50.3 to -27.4)* | 66.1 (49.5 to 87.7) | -32.3% (-41.8 to -23.5)* | 135.6 (98.0 to 186.4) | -13.9% (-26.4 to -4.2)* | 91.9 (66.5 to 126.7) | -1.3% (-11.2 to 8.0) | 50.6 (38.5 to 68.2) | 4.6% (-7.2 to 18.0) |
| Malaria | 619.8 (440.1 to 839.5) | -30.8% (-39.4 to -20.8)* | 354.3 (226.3 to 508.1) | -39.8% (-51.4 to -27.2)* | 54.3 (38.9 to 75.3) | -30.7% (-39.4 to -21.7)* | 109.0 (72.2 to 161.0) | -9.5% (-17.1 to -1.1)* | 71.2 (46.5 to 107.2) | -3.3% (-12.6 to 6.2) | 31.0 (20.8 to 46.4) | -10.8% (-19.4 to -2.0)* |
| Other infectious diseases | 830.5 (732.2 to 947.8) | -25.9% (-32.4 to -18.8)* | 414.0 (331.4 to 515.2) | -38.1% (-45.4 to -28.9)* | 60.6 (51.0 to 74.0) | -38.8% (-45.2 to -31.7)* | 143.3 (127.1 to 157.6) | -14.7% (-18.0 to -10.0)* | 110.5 (102.4 to 121.6) | 10.8% (6.3 to 17.4)* | 102.1 (94.1 to 110.9) | 19.6% (14.7 to 24.5)* |
| Meningitis | 288.0 (254.3 to 333.2) | -20.1% (-26.0 to -11.0)* | 153.1 (127.7 to 179.4) | -30.0% (-38.2 to -19.2)* | 23.4 (19.1 to 29.9) | -25.2% (-30.6 to -12.8)* | 54.7 (46.2 to 69.3) | -9.5% (-13.6 to -1.6)* | 31.8 (28.7 to 44.2) | 12.3% (6.0 to 20.0)* | 25.1 (22.5 to 35.7) | 13.8% (6.3 to 21.0)* |
| Maternal and neonatal disorders | 1977.4 (1890.1 to 2060.6) | -24.1% (-26.9 to -21.0)* | 1783.8 (1698.5 to 1864.7) | -24.1% (-27.2 to -20.6)* | 0.8 (0.7 to 0.9) | -18.5% (-28.5 to -4.9)* | 191.1 (177.5 to 206.9) | -24.2% (-28.6 to -19.6)* | 1.8 (1.6 to 2.0) | 2.1% (-7.6 to 14.1) | .. | .. |
| Neonatal disorders | 1783.8 (1698.5 to 1864.7) | -24.1% (-27.2 to -20.6)* | 1783.8 (1698.5 to 1864.7) | -24.1% (-27.2 to -20.6)* | .. | .. | .. | .. | .. | .. | .. | .. |
| Neonatal preterm birth | 649.4 (605.4 to 721.3) | -26.2% (-31.3 to -21.5)* | 649.4 (605.4 to 721.3) | -26.2% (-31.3 to -21.5)* | .. | .. | .. | .. | .. | .. | .. | .. |

(Table 2 continues on next page)

| | All-age deaths (thousands) | | Under-5 deaths (thousands) | | Deaths at age 5-14 years (thousands) | | Deaths at age 15-49 years (thousands) | | Deaths at age 50-69 years (thousands) | | Deaths at age ≥70 years (thousands) | |
|--|---|---|---|---|---|---|--|--|---|--|---|--|
| | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-2017 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 |
| (Continued from previous page) | | | | | | | | | | | | |
| Neonatal encephalopathy due to birth asphyxia and trauma | 533.3 (476.9 to 580.3) | -24.5% (-30.2 to -18.0)* | 533.3 (476.9 to 580.3) | -24.5% (-30.2 to -18.0)* | .. | .. | .. | .. | .. | .. | .. | .. |
| Other neonatal disorders | 349.0 (294.9 to 382.3) | -23.6% (-29.8 to -15.5)* | 349.0 (294.9 to 382.3) | -23.6% (-29.8 to -15.5)* | .. | .. | .. | .. | .. | .. | .. | .. |
| Nutritional deficiencies | 270.0 (249.3 to 295.5) | -23.9% (-29.2 to -15.7)* | 145.1 (128.0 to 163.6) | -38.7% (-44.8 to -30.2)* | 8.5 (7.3 to 9.9) | -35.3% (-42.7 to -25.8)* | 16.9 (15.6 to 18.8) | -12.9% (-17.8 to -4.5)* | 28.3 (26.6 to 31.0) | 8.1% (1.6 to 18.4)* | 71.2 (68.7 to 75.1) | 20.5% (15.6 to 27.9)* |
| Protein-energy malnutrition | 231.8 (212.4 to 254.2) | -26.1% (-31.7 to -17.9)* | 140.3 (123.6 to 158.8) | -38.3% (-44.4 to -29.8)* | 7.3 (6.2 to 8.5) | -32.1% (-39.8 to -21.3)* | 11.5 (10.4 to 13.1) | -10.6% (-15.9 to -1.1)* | 19.2 (17.6 to 21.1) | 6.2% (0.7 to 15.5)* | 53.6 (49.3 to 56.7) | 20.2% (16.3 to 26.0)* |
| Non-communicable diseases | 41071.1 (40470.9 to 41548.9) | 22.7% (21.5 to 23.9)* | 754.6 (707.5 to 804.4) | -16.9% (-21.7 to -12.6)* | 170.9 (157.6 to 182.2) | -9.1% (-12.5 to -5.5)* | 3654.7 (3583.2 to 3726.5) | 3.2% (1.7 to 4.7)* | 12516.7 (12332.4 to 12686.5) | 26.7% (25.1 to 28.2)* | 23974.3 (23625.0 to 24257.0) | 26.5% (25.3 to 27.7)* |
| Neoplasms | 9556.2 (9395.7 to 9692.3) | 25.4% (23.9 to 27.0)* | 49.9 (44.4 to 54.8) | -4.8% (-21.5 to 12.6) | 62.0 (56.7 to 66.8) | -2.8% (-9.6 to 3.4) | 1048.5 (1024.9 to 1072.5) | 5.7% (3.8 to 7.8)* | 3962.3 (3896.5 to 4024.2) | 31.0% (29.2 to 32.9)* | 4433.5 (4351.5 to 4493.0) | 27.2% (25.7 to 28.7)* |
| Colon and rectum cancer | 896.0 (876.3 to 915.7) | 27.8% (24.0 to 31.3)* | .. | .. | .. | .. | 68.2 (66.1 to 70.0) | 11.8% (6.0 to 16.3)* | 323.2 (314.8 to 331.3) | 32.2% (27.3 to 36.5)* | 504.7 (494.2 to 515.3) | 27.5% (24.5 to 30.5)* |
| Tracheal, bronchus, and lung cancer | 1883.1 (1844.2 to 1922.8) | 29.6% (26.5 to 32.5)* | .. | .. | .. | .. | 105.5 (102.5 to 108.9) | -1.0% (-4.1 to 1.8) | 861.5 (841.1 to 882.3) | 34.9% (31.3 to 38.1)* | 916.1 (897.6 to 934.8) | 29.5% (26.7 to 32.3)* |
| Cardiovascular diseases | 17790.9 (17527.1 to 18042.7) | 21.1% (19.7 to 22.6)* | 30.1 (28.2 to 32.3) | -31.3% (-35.2 to -27.2)* | 15.6 (14.5 to 16.9) | -18.7% (-22.9 to -15.4)* | 1258.0 (1234.6 to 1284.7) | 1.6% (-0.2 to 3.4) | 5152.1 (5068.6 to 5233.7) | 23.6% (21.7 to 25.5)* | 11335.1 (11173.0 to 11494.9) | 22.9% (21.6 to 24.3)* |
| Ischaemic heart disease | 8930.4 (8790.7 to 9138.7) | 22.3% (20.6 to 23.8)* | .. | .. | .. | .. | 643.8 (628.9 to 661.2) | 5.9% (3.7 to 8.3)* | 2649.1 (2602.9 to 2699.1) | 24.5% (22.3 to 26.6)* | 5637.5 (5547.9 to 5786.4) | 23.4% (21.8 to 24.8)* |
| Stroke | 6167.3 (6044.3 to 6327.6) | 16.6% (14.7 to 18.6)* | 7.5 (6.7 to 8.5) | -40.2% (-45.3 to -35.0)* | 5.1 (4.7 to 5.6) | -18.1% (-23.8 to -13.2)* | 364.2 (354.9 to 375.0) | 0.1% (-2.3 to 2.4) | 1836.6 (1795.9 to 1879.2) | 21.7% (19.2 to 24.3)* | 3953.8 (3875.7 to 4067.2) | 16.4% (14.6 to 18.3)* |
| Ischaemic stroke | 2747.4 (2657.1 to 2857.6) | 21.2% (19.0 to 23.3)* | 1.0 (0.8 to 1.3) | -36.8% (-44.6 to -29.3)* | 0.5 (0.4 to 0.6) | -18.1% (-27.8 to -10.6)* | 58.3 (53.4 to 64.9) | 2.0% (-1.6 to 5.5) | 575.2 (545.6 to 619.7) | 27.2% (23.7 to 30.8)* | 2112.4 (2052.7 to 2177.3) | 20.3% (18.3 to 22.3)* |
| Intracerebral haemorrhage | 2974.9 (2880.8 to 3072.8) | 12.5% (9.6 to 15.1)* | 3.3 (2.7 to 4.4) | -44.5% (-49.5 to -40.1)* | 2.7 (2.5 to 2.9) | -18.6% (-25.9 to -12.9)* | 238.9 (230.5 to 248.1) | -0.4% (-3.3 to 2.4) | 1088.7 (1050.2 to 1121.4) | 18.7% (15.8 to 21.7)* | 1641.3 (1589.9 to 1706.2) | 11.1% (8.2 to 13.6)* |
| Hypertensive heart disease | 925.7 (681.4 to 994.9) | 46.6% (26.3 to 59.3)* | .. | .. | .. | .. | 43.8 (32.4 to 49.2) | 10.7% (-0.3 to 21.3) | 224.2 (172.2 to 242.8) | 39.5% (25.0 to 52.5)* | 657.7 (473.8 to 710.6) | 52.5% (29.1 to 64.5)* |
| Chronic respiratory diseases | 3914.2 (3790.6 to 4044.8) | 15.8% (12.7 to 19.3)* | 10.7 (9.3 to 12.4) | -34.3% (-41.7 to -20.2)* | 6.8 (6.1 to 8.2) | -24.9% (-29.0 to -18.8)* | 163.0 (156.2 to 175.0) | -5.9% (-9.1 to -2.0)* | 1004.4 (971.0 to 1040.7) | 15.9% (12.4 to 20.0)* | 2729.3 (2637.9 to 2820.0) | 17.9% (14.6 to 21.4)* |
| Chronic obstructive pulmonary disease | 3197.8 (3029.0 to 3358.9) | 17.5% (13.3 to 21.1)* | 1.2 (0.9 to 1.8) | -29.1% (-40.3 to -15.6)* | 0.8 (0.7 to 1.0) | -16.6% (-28.1 to -5.2)* | 75.8 (67.9 to 90.1) | -2.9% (-8.6 to 1.7) | 760.8 (700.2 to 819.6) | 17.8% (13.0 to 22.6)* | 2359.1 (2256.9 to 2448.6) | 18.3% (14.3 to 21.6)* |
| Digestive diseases | 2377.7 (2295.1 to 2518.0) | 15.3% (12.1 to 19.7)* | 40.2 (34.5 to 45.6) | -14.8% (-31.9 to 0.2) | 20.4 (17.0 to 23.3) | -14.0% (-23.9 to -3.2)* | 478.2 (454.0 to 510.7) | -1.0% (-4.2 to 3.6) | 884.1 (853.6 to 951.9) | 20.7% (16.6 to 26.4)* | 954.9 (927.8 to 1014.4) | 23.1% (19.2 to 28.9)* |

(Table 2 continues on next page)

| | All-age deaths (thousands) | | Under-5 deaths (thousands) | | Deaths at age 5-14 years (thousands) | | Deaths at age 15-49 years (thousands) | | Deaths at age 50-69 years (thousands) | | Deaths at age ≥70 years (thousands) | |
|--|--------------------------------------|----------------------------------|-----------------------------------|-------------------------------------|--------------------------------------|-------------------------------------|---------------------------------------|-------------------------------------|---------------------------------------|----------------------------------|--------------------------------------|----------------------------------|
| | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-2017 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 | 2017 | Percentage change, 2007-17 |
| (Continued from previous page) | | | | | | | | | | | | |
| Cirrhosis and other chronic liver diseases | 1322.9 (1268.2 to 1449.1) | 15.0% (8.7 to 21.5)* | 7.8 (6.3 to 9.6) | -14.9% (-36.9 to 11.1) | 8.4 (7.0 to 10.0) | -14.1% (-23.5 to -0.1)* | 332.1 (316.4 to 362.3) | -0.4% (-5.2 to 4.7) | 592.2 (563.4 to 653.6) | 21.0% (14.4 to 28.7)* | 382.3 (364.3 to 425.8) | 24.0% (15.6 to 33.9)* |
| Neurological disorders | 3094.2 (3039.6 to 3142.6) | 42.1% (40.2 to 43.9)* | 18.2 (16.1 to 21.4) | -18.2% (-27.7 to 6.6) | 11.4 (10.2 to 13.2) | -14.1% (-21.2 to -0.7)* | 86.6 (80.8 to 98.1) | 0.5% (-3.7 to 8.1) | 244.5 (239.4 to 250.8) | 38.2% (36.0 to 40.6)* | 2733.5 (2683.3 to 2772.6) | 45.5% (43.5 to 47.2)* |
| Alzheimer's disease and other dementias | 2514.6 (2470.5 to 2550.3) | 46.2% (43.9 to 48.0)* | .. | .. | .. | .. | 2.8 (2.8 to 2.9) | 11.2% (7.5 to 14.9)* | 138.3 (135.4 to 141.4) | 39.6% (36.0 to 42.5)* | 2373.5 (2329.6 to 2407.2) | 46.7% (44.4 to 48.5)* |
| Diabetes and kidney diseases | 2611.2 (2557.8 to 2667.2) | 34.2% (32.0 to 36.2)* | 15.0 (13.6 to 16.5) | -22.3% (-27.6 to -16.3)* | 10.2 (9.3 to 11.1) | -14.6% (-20.0 to -9.9)* | 278.3 (270.4 to 287.1) | 8.5% (6.2 to 11.0)* | 940.9 (921.7 to 959.9) | 39.4% (36.7 to 42.0)* | 1366.7 (1338.8 to 1395.2) | 38.9% (36.8 to 40.8)* |
| Diabetes mellitus | 1369.8 (1340.3 to 1401.9) | 34.7% (32.2 to 37.3)* | 1.7 (1.4 to 2.0) | -11.2% (-19.6 to -2.9)* | 1.9 (1.5 to 2.2) | -10.6% (-21.1 to -1.2)* | 113.8 (111.0 to 116.8) | 13.5% (10.5 to 16.2)* | 535.0 (523.9 to 547.0) | 38.9% (36.0 to 41.9)* | 717.4 (700.6 to 736.2) | 36.1% (33.4 to 38.7)* |
| Type 2 diabetes mellitus | 1024.3 (985.5 to 1066.8) | 43.0% (40.4 to 45.8)* | .. | .. | .. | .. | 49.3 (46.6 to 52.3) | 31.1% (26.2 to 35.7)* | 380.9 (365.6 to 396.6) | 48.0% (44.6 to 51.7)* | 594.1 (572.3 to 620.5) | 41.0% (38.6 to 43.6)* |
| Chronic kidney disease | 1230.2 (1195.1 to 1258.8) | 33.7% (30.5 to 36.1)* | 13.0 (11.7 to 14.4) | -23.0% (-28.9 to -16.7)* | 8.0 (7.3 to 8.8) | -15.0% (-20.3 to -10.4)* | 162.6 (155.5 to 169.4) | 5.7% (3.0 to 8.6)* | 402.3 (383.6 to 412.1) | 40.3% (35.6 to 43.7)* | 644.3 (628.3 to 659.3) | 42.2% (38.9 to 44.4)* |
| Other non-communicable diseases | 1153.3 (1101.8 to 1208.3) | 0.8% (-3.9 to 4.0) | 584.4 (544.2 to 628.8) | -16.6% (-22.5 to -12.2)* | 42.0 (37.4 to 46.4) | -5.0% (-10.5 to -0.6)* | 130.3 (120.8 to 141.4) | 5.6% (2.6 to 8.3)* | 142.8 (131.2 to 150.3) | 39.3% (36.3 to 42.3)* | 253.7 (236.5 to 262.6) | 46.4% (43.8 to 49.4)* |
| Injuries | 4484.7 (4332.0 to 4585.6) | 2.3% (0.5 to 4.0)* | 270.5 (249.7 to 289.4) | -26.6% (-31.3 to -18.6)* | 208.7 (194.4 to 221.4) | -16.5% (-18.7 to -13.7)* | 2062.5 (1998.4 to 2105.8) | -5.8% (-7.2 to -4.4)* | 1018.6 (975.0 to 1047.8) | 18.9% (14.8 to 21.9)* | 924.5 (889.7 to 956.7) | 28.3% (23.4 to 33.6)* |
| Transport injuries | 1335.0 (1289.1 to 1369.5) | -3.1% (-6.0 to -0.6)* | 52.4 (47.0 to 57.7) | -30.1% (-36.1 to -16.0)* | 66.7 (61.9 to 71.7) | -19.2% (-22.4 to -15.6)* | 720.2 (699.9 to 740.6) | -10.3% (-13.3 to -7.5)* | 335.0 (316.0 to 344.8) | 19.9% (12.4 to 24.4)* | 160.7 (153.8 to 165.0) | 16.9% (10.2 to 20.7)* |
| Road injuries | 1243.1 (1191.9 to 1276.9) | -3.2% (-6.3 to -0.5)* | 49.1 (44.0 to 54.2) | -30.0% (-36.1 to -14.9)* | 62.4 (57.9 to 67.3) | -19.3% (-22.4 to -15.4)* | 669.1 (644.9 to 688.7) | -10.5% (-13.5 to -7.6)* | 311.7 (292.2 to 321.5) | 20.0% (12.3 to 24.5)* | 150.8 (143.8 to 155.1) | 16.7% (9.8 to 20.5)* |
| Pedestrian road injuries | 486.2 (459.7 to 535.0) | -6.4% (-11.7 to -2.1)* | 24.0 (21.1 to 28.3) | -36.8% (-42.8 to -26.4)* | 31.2 (28.0 to 35.3) | -25.0% (-29.1 to -20.5)* | 203.7 (191.6 to 227.0) | -15.2% (-19.8 to -10.5)* | 141.8 (133.0 to 154.8) | 14.7% (5.4 to 21.9)* | 85.5 (80.8 to 91.1) | 12.7% (3.6 to 18.2)* |
| Motorcyclist road injuries | 225.7 (196.1 to 238.6) | -0.6% (-8.9 to 5.2) | 3.5 (3.0 to 4.1) | -25.4% (-37.6 to -3.7)* | 5.2 (4.4 to 5.9) | -13.4% (-21.3 to -5.2)* | 161.5 (142.6 to 171.6) | -8.0% (-15.0 to -2.6)* | 45.6 (37.4 to 49.3) | 36.8% (17.1 to 48.9)* | 9.8 (7.9 to 10.6) | 32.5% (12.4 to 44.8)* |
| Motor vehicle road injuries | 451.1 (423.4 to 472.9) | -2.5% (-6.2 to 1.3) | 19.9 (16.5 to 22.9) | -21.5% (-31.6 to 3.0) | 21.3 (19.2 to 23.4) | -12.3% (-17.1 to -3.0)* | 268.5 (254.4 to 284.6) | -8.9% (-12.5 to -5.5)* | 97.6 (88.9 to 103.9) | 19.8% (10.1 to 25.2)* | 43.7 (40.5 to 46.1) | 18.8% (9.9 to 23.4)* |
| Unintentional injuries | 1804.9 (1695.7 to 1872.0) | 2.9% (0.5 to 6.0)* | 191.5 (175.1 to 206.9) | -29.2% (-34.2 to -22.4)* | 106.2 (96.6 to 114.9) | -22.7% (-25.6 to -19.4)* | 486.0 (447.7 to 509.0) | -12.3% (-14.0 to -10.2)* | 395.8 (363.7 to 416.0) | 19.4% (15.0 to 24.2)* | 625.4 (591.5 to 653.4) | 35.9% (29.8 to 42.9)* |
| Falls | 695.8 (644.9 to 741.7) | 27.4% (21.2 to 35.6)* | 20.4 (17.5 to 22.9) | -16.7% (-31.4 to 1.0) | 12.9 (11.1 to 14.7) | -7.0% (-18.0 to 4.0) | 102.6 (90.7 to 109.2) | -1.0% (-5.6 to 5.7) | 155.4 (140.0 to 169.0) | 31.1% (22.9 to 42.0)* | 404.5 (381.7 to 433.2) | 41.6% (33.4 to 52.1)* |
| Drowning | 295.2 (284.5 to 306.2) | -17.2% (-19.8 to -14.1)* | 59.8 (54.3 to 65.9) | -41.8% (-46.7 to -34.9)* | 49.7 (45.8 to 53.5) | -26.3% (-29.5 to -22.9)* | 99.2 (96.5 to 102.3) | -14.5% (-16.9 to -11.7)* | 48.8 (46.6 to 50.2) | 19.6% (16.2 to 22.9)* | 37.6 (35.1 to 38.7) | 28.6% (24.7 to 32.0)* |
| Fire, heat, and hot substances | 120.6 (101.6 to 129.4) | -7.9% (-10.9 to -5.2)* | 17.2 (13.1 to 20.0) | -25.3% (-34.6 to -15.2)* | 5.9 (4.7 to 7.0) | -22.4% (-28.2 to -12.2)* | 40.8 (32.6 to 45.8) | -16.1% (-19.8 to -9.7)* | 25.1 (21.5 to 26.8) | 4.0% (-4.5 to 9.6) | 31.6 (28.3 to 33.1) | 14.4% (7.4 to 19.2)* |
| Exposure to mechanical forces | 136.5 (117.6 to 143.2) | -6.7% (-9.8 to -3.7)* | 13.5 (11.0 to 15.2) | -22.4% (-28.4 to -15.2)* | 7.1 (6.2 to 7.8) | -19.9% (-23.6 to -15.9)* | 63.0 (54.9 to 66.0) | -15.9% (-19.1 to -12.2)* | 33.3 (27.5 to 35.2) | 14.0% (9.1 to 18.6)* | 19.6 (17.3 to 20.9) | 22.8% (17.8 to 28.0)* |

(Table 2 continues on next page)

| | All-age deaths (thousands) | | Under-5 deaths (thousands) | | Deaths at age 5–14 years (thousands) | | Deaths at age 15–49 years (thousands) | | Deaths at age 50–69 years (thousands) | | Deaths at age ≥70 years (thousands) | |
|---|--|-------------------------------------|--------------------------------------|---------------------------------------|--------------------------------------|--|---|-------------------------------------|---|--|---|---------------------------------------|
| | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–2017 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 | 2017 | Percentage change, 2007–17 |
| (Continued from previous page) | | | | | | | | | | | | |
| Adverse effects of medical treatment | 121.6 (103.6 to 137.6) | 16.6% (12.0 to 20.9)* | 13.5 (9.8 to 20.0) | -12.1% (-24.2 to 4.9) | 3.4 (2.9 to 4.0) | -9.4% (-16.9 to 1.4) | 28.6 (23.7 to 31.1) | 4.1% (-1.7 to 10.2) | 31.6 (26.7 to 34.8) | 30.8% (22.7 to 40.5)* | 44.5 (39.4 to 49.8) | 32.9% (26.4 to 40.6)* |
| Foreign body | 124.1 (119.3 to 130.0) | 1.7% (-1.9 to 4.8) | 38.5 (34.9 to 42.0) | -21.8% (-26.8 to -15.7)* | 5.1 (4.7 to 5.6) | -4.2% (-9.7 to 0.7) | 21.8 (21.0 to 22.8) | -4.5% (-7.4 to -2.6)* | 21.3 (20.6 to 21.9) | 17.4% (14.4 to 19.5)* | 37.4 (36.5 to 38.5) | 41.3% (38.3 to 44.1)* |
| Pulmonary aspiration and foreign body in airway | 115.7 (111.4 to 121.3) | 1.9% (-1.9 to 5.0) | 37.0 (33.9 to 40.5) | -21.3% (-26.5 to -15.3)* | 4.7 (4.3 to 5.1) | -2.2% (-8.2 to 3.2) | 19.0 (18.3 to 19.8) | -4.5% (-7.2 to -2.5)* | 19.8 (19.1 to 20.3) | 17.1% (14.2 to 19.2)* | 35.3 (34.3 to 36.2) | 41.3% (38.3 to 44.2)* |
| Self-harm and interpersonal violence | 1344.8 (1283.1 to 1380.4) | 7.3% (4.6 to 9.7)* | 26.6 (24.2 to 28.6) | 15.0% (8.1 to 25.1)* | 35.8 (34.1 to 37.4) | 19.9% (15.8 to 24.3)* | 856.3 (817.6 to 882.2) | 2.9% (0.3 to 5.2)* | 287.7 (273.1 to 295.9) | 17.2% (13.2 to 21.4)* | 138.4 (131.3 to 143.1) | 12.9% (8.6 to 20.6)* |
| Self-harm | 793.8 (743.5 to 819.7) | 1.1% (-2.6 to 3.7) | .. | .. | 8.1 (7.3 to 8.8) | -13.0% (-19.5 to -7.2)* | 453.8 (425.2 to 469.5) | -6.1% (-9.8 to -3.3)* | 213.1 (199.0 to 219.5) | 14.6% (10.4 to 19.0)* | 118.8 (111.8 to 123.1) | 11.2% (6.8 to 19.5)* |
| Self-harm by other specified means | 730.0 (678.5 to 754.9) | 0.6% (-3.2 to 3.4) | .. | .. | 7.7 (6.9 to 8.5) | -13.2% (-19.9 to -7.2)* | 418.6 (389.8 to 434.5) | -6.2% (-10.1 to -3.4)* | 195.1 (180.2 to 201.8) | 13.8% (9.5 to 18.2)* | 108.6 (101.2 to 112.8) | 10.1% (5.6 to 18.7)* |
| Interpersonal violence | 405.3 (365.2 to 431.7) | 0.5% (-2.0 to 3.2) | 11.8 (9.5 to 13.7) | -21.2% (-29.1 to -7.7)* | 10.8 (9.2 to 12.3) | -15.6% (-20.1 to -10.4)* | 304.7 (275.0 to 322.3) | -0.5% (-3.1 to 2.4) | 62.4 (56.2 to 68.5) | 13.0% (8.0 to 17.8)* | 15.6 (13.9 to 17.1) | 10.1% (4.5 to 14.9)* |
| Physical violence by firearm | 174.4 (147.9 to 188.9) | 7.5% (4.3 to 10.8)* | 2.0 (1.3 to 2.5) | -14.0% (-24.6 to 2.6) | 2.8 (2.3 to 3.2) | -12.8% (-17.3 to -7.7)* | 145.5 (124.4 to 156.8) | 5.6% (2.3 to 9.3)* | 20.4 (16.8 to 22.8) | 27.2% (22.6 to 32.0)* | 3.8 (3.0 to 4.4) | 24.7% (20.1 to 29.8)* |
| Physical violence by other means | 139.5 (123.6 to 164.4) | 1.3% (-3.4 to 5.6) | 8.4 (6.9 to 9.9) | -23.8% (-31.7 to -10.5)* | 6.5 (5.5 to 7.7) | -16.4% (-21.9 to -9.7)* | 90.9 (79.9 to 107.7) | 3.5% (-1.9 to 8.3) | 25.9 (23.3 to 30.3) | 8.8% (0.3 to 16.3)* | 7.9 (7.0 to 9.1) | 6.6% (-2.5 to 13.7) |
| Conflict and terrorism | 129.7 (118.1 to 143.2) | 118.0% (88.8 to 148.6)* | 14.3 (11.7 to 17.4) | 78.7% (33.3 to 136.7)* | 16.2 (13.4 to 19.9) | 116.3% (64.0 to 187.1)* | 85.4 (75.1 to 98.4) | 121.3% (80.6 to 165.5)* | 10.1 (8.6 to 12.1) | 158.6% (108.0 to 220.8)* | 3.7 (3.2 to 4.3) | 144.1% (103.4 to 193.7)* |

Data in parentheses are 95% uncertainty intervals. YLL=years of life lost. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. *Statistically significant increases or decreases.

Table 2: Selected causes of global deaths by age groups (<5 years, 5–14 years, 15–49 years, 50–69 years, and ≥70 years) in 2017, with percentage change between 2007 and 2017, for both sexes combined

category. Deaths from conflict and terrorism, despite substantial limitations to their enumeration, were estimated to have increased greatly, rising by 118.0% (95% UI 88.8–148.6) in 2007–17 (table 1). Of deaths related to conflict and terrorism, 16 200 (13 400–19 800) were among people aged 5–14 years and 14 300 (11 700–17 300) occurred for children younger than 5 years; combined, these deaths represented 23.5% (20.5–26.9) of all deaths from conflict and terrorism (table 2).

Age-specific and sex-specific mortality for causes of death

Progress in reducing deaths was not equal between age groups (table 2). Total deaths from lower respiratory infections decreased by 36.4% (95% UI 32.2–40.6) between 2007 and 2017 for children younger than 5 years, while an increase of 33.6% (31.2–36.1) was estimated among older adults (≥70 years). A parallel pattern occurred for deaths from diarrhoeal diseases

between 2007 and 2017, which decreased by 40.6% (32.2–47.8) for children younger than 5 years, and increased by 15.0% (4.5–31.1) for adults older than 70 years.

Decreases among aetiologies of infection over the wider time period 1990–2017 included decreases in deaths from pneumococcal pneumonia (71.2% [95% UI 67.1–75.1]), respiratory syncytial virus pneumonia (64.2% [59.4–68.2]), influenza (66.0% [61.6–69.9]), and *H influenzae* type B pneumonia (82.5% [80.0–85.2]) for children younger than 5 years (appendix 2). Among adults older than 70 years, deaths increased from pneumococcal pneumonia (60.4% [39.7–79.9]), influenza (91.1% [82.3–99.6]), and respiratory syncytial virus pneumonia (100.3% [92.4–108.6]) between 1990 and 2017. Diarrhoeal deaths due to *C difficile* increased among adults older than 70 years (779.9% [736.7–831.0]), and for diarrhoeal diseases overall (44.0% [24.7–84.6]); by contrast,

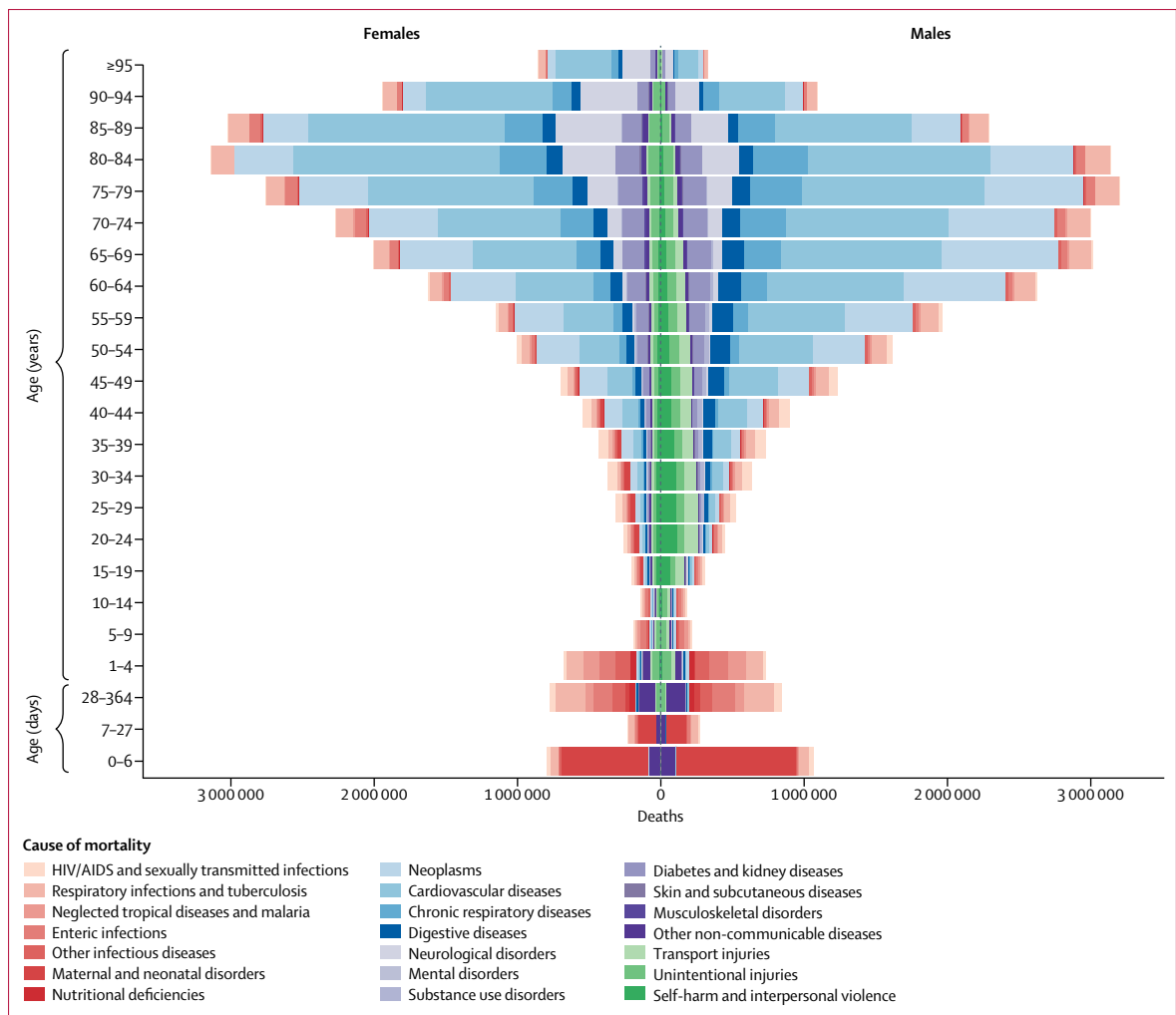


Figure 4: Sex difference in global mortality for 21 Level 2 causes by age, 2017

This figure represents the difference in mortality between females and males, as well as the cause composition of those differences for each GBD age group for the Level 2 causes in GBD 2017. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study.

diarrhoeal disease deaths declined by 67.9% (61.1–73.1) between 1990 and 2017 for children younger than 5 years.

At a global scale, total deaths were greater for men than for women at most ages in 2017; exceptions included ages 80–84 years (women, 3.30 million [95% UI 3.26–3.35] deaths; men, 3.14 million [3.10–3.18] deaths), 85–89 years (women, 3.02 million [2.99–3.05] deaths; men, 2.29 million [2.27–2.32] deaths), 90–94 years (women, 1.94 million [1.92–1.96] deaths; men, 1.09 million [1.09–1.10] deaths), and 95 years and older (women, 858 000 deaths [852 000–864 000]; men, 329 000 deaths [327 000–331 000]; figure 4). Across causes, the largest female-to-male ratio of deaths occurred for neurological disorders (women ≥85 years, 1.05 million [1.04–1.07] deaths; men ≥85 years, 475 000 deaths [464 000–483 000]) and for cardiovascular diseases (women ≥85 years, 2.65 million [2.61–2.69] deaths; men ≥85 years, 1.56 million [1.53–1.58] deaths).

Overall, deaths from injury were also greater for men than for women (3.07 million [2.95–3.14] vs 1.42 million [1.36–1.46]) and in each five-year age group up to age 85 years (122 000 deaths [112 000–128 000] for men aged ≥85 years vs 173 000 deaths [166 000–181 000] for women aged ≥85 years).

Patterns in rates of change in global cause-specific mortality rate

To better understand recent changes across a wide range of causes, we present the distribution of the percentage change in mortality rate at the country level by Level 1 causes and over three time periods (2003–07, 2008–12, and 2013–17; figure 5A, 5B, 5C). At Level 1 of the GBD cause hierarchy, a decrease in the global percentage change in CSMR was evident between time periods, particularly for NCDs, although this varied by SDI quintile. Globally, the percentage change in mortality

rate for NCDs was smaller in the most recent period, slowing from a decrease of 7.8% (95% UI 7.5–8.2) over the 2003–07 period to a decrease of 2.1% (1.5–2.7) for 2013–17. For CMNN causes, the largest decrease in percentage change occurred at high SDI quintiles, from a decrease of 8.8% (8.1–9.4) for 2003–07 to a decrease of 3.0% (1.7–4.2) for 2013–17. Increases in the magnitude of the percentage change between 2003–07 and 2013–17 for CMNN causes were estimated at low SDI quintiles (from a decrease of 12.9% [11.6–14.1] for 2003–07 to a decrease of 13.9% [12.1–15.5] for 2013–17), low-middle SDI quintiles (from a decrease of 11.2% [9.8–12.6] for 2003–07 to a decrease of 13.5% [11.4–15.5] for 2013–17), and middle SDI quintiles (from a decrease of 11.8% [10.8–12.8] for 2003–07 to a decrease of 15.6% [14.3–16.7] for 2013–17; figure 5A). For NCDs, the largest decrease in percentage change was for high-middle SDI quintiles, from 11.5% (10.8–12.2) in 2003–07 to 4.5% (3.2–5.7) in 2013–17 (figure 5B). Across injury causes of death, the largest decrease in the magnitude of change occurred at high-middle SDI quintiles (from a decrease of 16.1% [15.2–16.9] for 2003–07 to a decrease of 7.0% [5.5–8.3] for 2013–17), while an increase in magnitude was estimated at low-middle SDI quintiles (from a decrease of 2.1% [0.7–3.6] for 2003–07 to a decrease of 6.3% [4.0–8.6] for 2013–17; figure 5C).

Epidemiological transitions

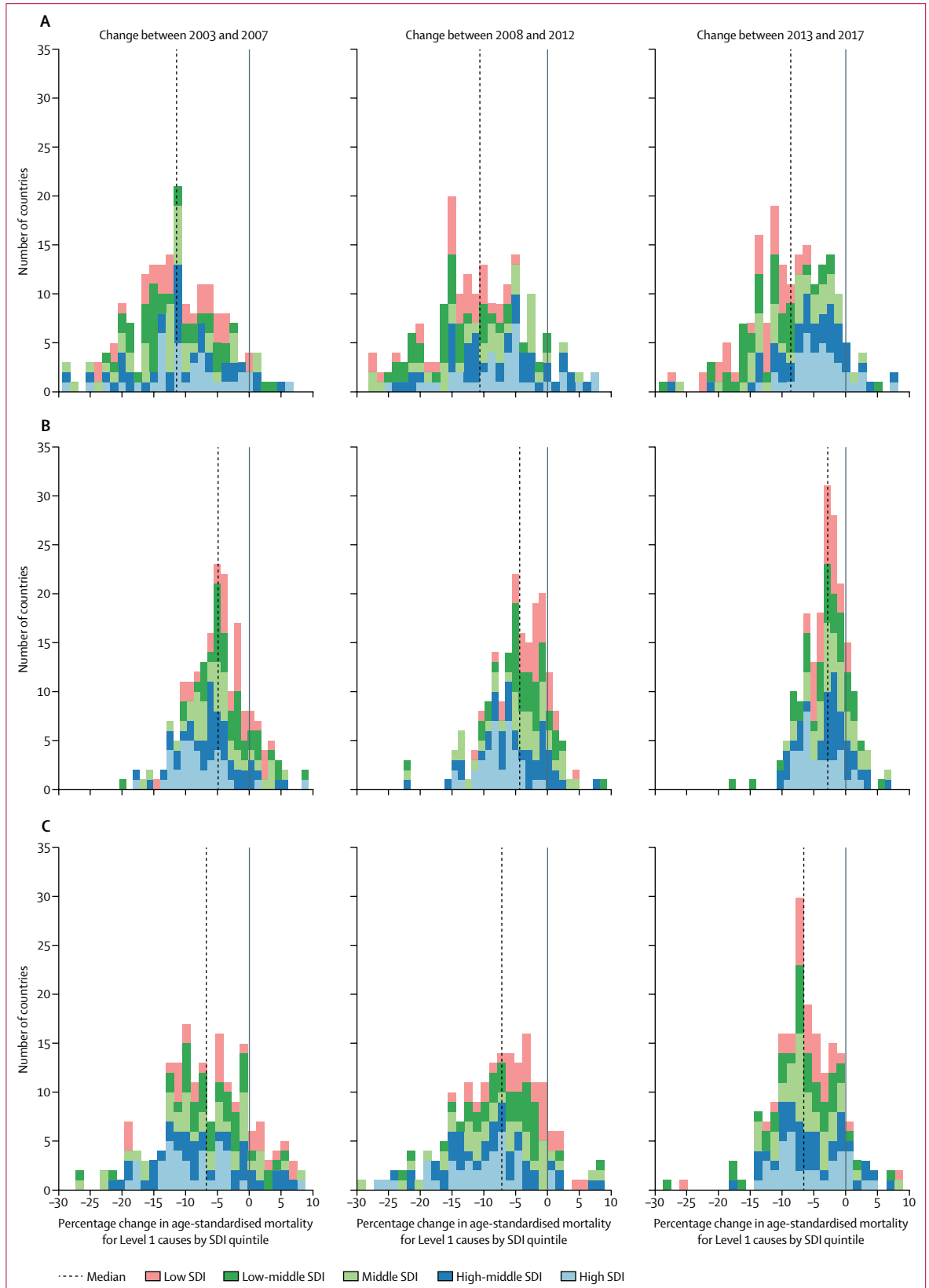
The five leading causes of YLLs at Level 2 of the GBD cause hierarchy, together with injuries, by SDI level are shown in figure 6A. The greatest total YLLs for enteric infections in 2017 were at low SDI (42.6 million [95% UI 37.1–50.5] YLLs) and low-middle SDI quintiles (33.4 million [28.4–40.3] YLLs), but with a large decrease from 1990, when YLLs were 83.2 million (69.6–95.8) in low SDI countries and 76.9 million (63.9–89.4) in low-middle SDI countries; changes in respiratory infections and tuberculosis followed a similar pattern. Similarly, YLLs from maternal and neonatal disorders remained high for both low SDI and low-middle SDI countries, despite a large decrease in total YLLs from 87.5 million (76.0–103.0) in 1990 to 71.1 million (66.9–75.5) in 2017 for low SDI countries and from 98.0 million (89.2–108.0) in 1990 to 67.3 million (62.3–72.4) in 2017 for low-middle SDI countries. The impact of premature death due to neoplasms has risen across SDI levels but with the largest increases in low-middle SDI countries (15.1 million [13.6–17.3] YLLs in 1990 vs 35.0 million [33.4–36.8] YLLs in 2017) and middle SDI countries (30.6 million [28.9–33.5] YLLs in 1990 vs 62.0 million [60.1–63.8] YLLs in 2017). YLLs from cardiovascular diseases increased at all SDI levels with the exception of high SDI countries, where total YLLs fell from 60.6 million (60.2–61.0) in 1990 to 41.4 million (40.8–42.2) in 2017. Total YLLs from injuries (self-harm and interpersonal violence, transport injuries, and unintentional injuries) at certain time periods exceeded those from the global leading causes of death;

from 1980 to 2017 this increase occurred most often at lower SDI levels, and even with YLL rates slowly decreasing during this time period. Low SDI countries had a decrease in the rate of YLLs due to self-harm, falling from 604.4 (499.7–712.0) per 100 000 in 1980 to 441.4 (410.9–479.2) per 100 000 in 2017, but still remained higher than in all other SDI quintiles. In general, the precision of estimates was lower at lower SDI levels, represented by the wider 95% UIs across causes, which reflects the availability of data for these locations.

Despite increasing populations and changes in population age-structure, YLL rates decreased across the five leading Level 2 GBD causes of YLLs in all SDI quintiles (figure 6B). Large decreases in YLL rates were estimated at low SDI levels for respiratory infections and tuberculosis (from 14 900 [95% UI 13 000–16 600] YLLs per 100 000 in 1980 to 4750 [4505–4990] YLLs per 100 000 in 2017). Rates for enteric infections also decreased rapidly at low SDI levels (from 12 600 [9990–15 300] YLLs per 100 000 in 1980 to 3180 [2670–4090] YLLs per 100 000 in 2017) and low-middle SDI levels (9310 [7640–11 300] YLLs per 100 000 in 1980 to 2020 [1670–2500] YLLs per 100 000 in 2017). The YLL rate also decreased for cardiovascular diseases and for neoplasms across all SDI levels despite increases in the total number of YLLs. YLL rates for cervical cancer at low SDI levels—a cancer of infectious aetiology—decreased from 317 (242–373) YLLs per 100 000 to 191 (173–211) YLLs per 100 000 (appendix 2). At the same time, cancers such as pancreatic cancer—driven substantially by non-infectious risks—increased at low SDI levels from 38.6 (31.2–50.0) YLLs per 100 000 to 55.9 (51.9–60.0) YLLs per 100 000 (appendix 2).

Leading causes of global YLLs

Figure 7 shows the ongoing epidemiological shift in leading causes of total YLLs from CMNN diseases to NCDs at Level 3 of the GBD cause hierarchy over the 1990–2007 period and for 2007–17. Globally, the leading causes of YLLs in 1990 were neonatal disorders (ranked first), lower respiratory infections (second), and diarrhoeal diseases (third). Estimated YLLs decreased by 21.2% (95% UI 16.6–25.8) for neonatal disorders, by 38.6% (34.3–42.0) for lower respiratory infections, and by 39.5% (32.6–45.4) for diarrhoeal diseases, from 1990 to 2007, and by a further 24.1% (20.6–27.2), 25.9% (22.2–29.2), and 32.0% (23.9–38.6), from 2007 to 2017. YLL rates also decreased during the entire 1990–2017 time period for neonatal disorders (from 4059.1 [3802.1–4336.0] YLLs per 100 000 to 2377.2 [2263.7–2485.1] YLLs per 100 000), lower respiratory infections (from 3821.4 [3509.9–4093.3] YLLs per 100 000 to 1515.1 [1424.8–1602.2] YLLs per 100 000), and diarrhoeal diseases (from 2843.6 [2415.0–3280.8] YLLs per 100 000 to 1009.1 [870.5–1211.0] YLLs per 100 000). In 2017, neonatal disorders were ranked second, lower respiratory infections fourth, and diarrhoeal diseases fifth in terms of total YLLs. Estimated YLLs from ischaemic heart disease, ranked first, increased by 20.9% (19.0–22.9)



from 1990 to 2007, and by a further 17·3% (15·4–19·0) from 2007 to 2017, while estimated YLLs from stroke, ranked third, increased by 12·9% (10·6–15·2) from 1990 to 2007, and by a further 12·1% (9·9–14·1) from 2007 to 2017. However, decreases in YLL rates were estimated for ischaemic heart disease between 1990 and 2007 (20·2% [19·0–21·4]), and from 2007 to 2017 (9·8% [8·5–11·2]). YLL rates for stroke decreased by 24·0% (22·5–25·4) from 1990 to 2007, and by 13·8% (12·3–15·5) from 2007 to 2017. Other leading NCD causes of YLLs in 2017 included congenital anomalies (ranked ninth), and chronic obstructive pulmonary disease (seventh); other leading CMNN causes included lower respiratory infections (fourth), diarrhoeal diseases (fifth), HIV/AIDS (eighth), and malaria (tenth). The only injury cause of death in the leading ten causes of YLLs in 2017 was road injuries, for which the YLL rate decreased by 18·4% (14·4–22·0) from 1990 to 2007, with a further decrease of 19·6% (17·5–21·6) from 2007 to 2017, but with an increase in relative rank as a source of total YLLs from eighth in 1990 to sixth in 2017.

YLLs and Socio-demographic Index level

The association between SDI level and YLL rates for each GBD region for each year between 1990 and 2017 is illustrated for CMNN causes, NCDs, and injuries in figure 8. In general, YLL rates decreased as SDI for a given region increased, with some exceptions. Among these, the YLL rate in southern sub-Saharan Africa was distinctly non-linear, increasing across CMNN causes even as SDI level increased before decreasing by a similar amount against a backdrop of rising SDI level. Southern sub-Saharan Africa achieved a higher SDI level than did other regions of sub-Saharan Africa, although not necessarily consistently lower YLL rates for CMNN causes than the other regions of sub-Saharan Africa. Variation in the association between YLL rate for NCDs and SDI in the regions of central Asia and eastern

Europe was observed, with the highest YLL rate observed in 2005 for central Asia, and in 1994 for eastern Europe. An end to previous declines in the YLL rate for NCDs at highest SDI (in the most recent years) was observed for high-income North America and Australasia. The impact of fatal discontinuities can be seen in the large spikes in YLL rates estimated in eastern sub-Saharan Africa in 1994, reflecting mortality from the genocide in Rwanda, and in the Caribbean region where the 2010 earthquake in Haiti resulted in a YLL rate 2·5 times greater than the level expected in that year given the SDI level.

Decomposition of driving factors in epidemiological change for selected causes

Changes in mortality are driven by population growth, population ageing, and changes in CSMR. The relative contributions of these factors to the change in total mortality for the 20 leading Level 2 causes of mortality from 2007 to 2017 are shown in figure 9. Population growth was an important contributor to increased levels of mortality across all causes. Declines in CSMR counterbalanced this effect for all but three causes—substance use disorders, neurological disorders, and skin and subcutaneous diseases. Without these decreases in CSMR, population ageing and growth would have resulted in increased mortality for most causes. Although population ageing led to increases in total deaths for most leading causes, for some causes—particularly neonatal conditions or other causes that primarily affect children—population ageing contributed to reductions for maternal and neonatal disorders (13·0%), neglected tropical diseases and malaria (3·9%), other infectious diseases (3·3%), other NCDs (1·6%), and nutritional deficiencies (1·3%). Changes in CSMR contributed the largest fraction to estimated changes in total deaths for 12 leading causes. CSMR contributed to 66·5% of the decrease in deaths from HIV/AIDS and to 8·1% of the increase in substance use disorders.

Discussion

High-level conclusions from the new health estimates of GBD 2017

General trends

The results of GBD 2017 show that, globally, CMNN diseases have declined steadily since 1990 in terms of total numbers of deaths and death rates. Global malaria deaths peaked in 2004 and HIV/AIDS-related deaths peaked in 2006, reflecting investments in the delivery of antiretroviral therapies, insecticide-treated bednets, and other interventions. NCDs, including both cardiovascular diseases and cancers, have risen steadily since 1990 in terms of total number of deaths, driven by ageing and population growth, while death rates have decreased, more slowly in the most recent years, as a result of improvements in prevention strategies and health-care

Figure 5: Distribution of percentage change in age-standardised mortality rate for Level 1 causes by SDI quintile

(A) Communicable, maternal, neonatal, and nutritional diseases.

(B) Non-communicable diseases. (C) Injuries. The figure shows the distribution of the percentage change in the age-standardised mortality rate by Level 1 cause over the three 5-year periods (2003–07, 2008–12, and 2013–17). The colours represent SDI quintiles. The solid line represents no change in the age-standardised mortality rate during the specified 5-year period. The dotted line represents the median over all countries in the percentage change. Countries that were outliers (>30% decrease or a 10% increase in a given time period) were removed from the figure in order to better distinguish the shape of the distribution. For communicable, maternal, neonatal, and nutritional diseases, the following countries were excluded: Finland, Georgia, Lithuania, Rwanda, Serbia, South Africa, Turkey, and Ukraine in 2003–07; Botswana, Croatia, Dominica, Malawi, Namibia, Zambia, and Zimbabwe in 2008–12; and Botswana, Lesotho, South Africa, and Swaziland in 2013–17. For injuries, the following were excluded: Afghanistan, Burundi, Cape Verde, Comoros, Georgia, Iran, Iraq, Jamaica, Liberia, São Tomé and Príncipe, Spain, and Trinidad and Tobago in 2003–07; El Salvador, Honduras, Israel, Libya, Mexico, Myanmar, Palestine, Samoa, South Sudan, Sri Lanka, Syria, and Ukraine in 2008–12; and Afghanistan, Honduras, Iraq, Libya, Puerto Rico, Ukraine, and Yemen in 2013–17. SDI=Socio-demographic Index.

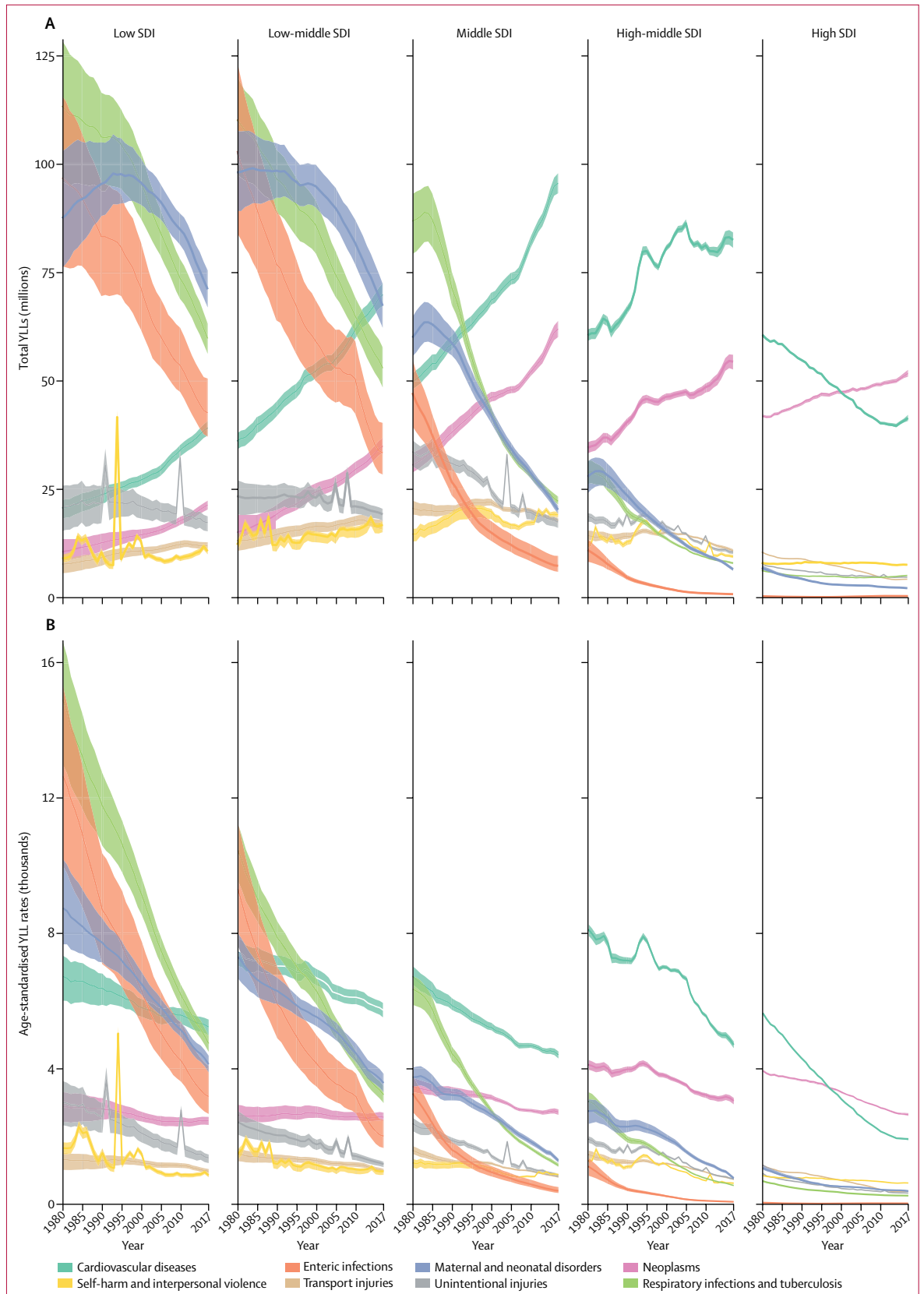


Figure 6: Trends of total YLLs (A) and age-standardised YLL rates (B) for both sexes combined from 1980 to 2017, by top five GBD Level 2 causes in 2017, by SDI quintile
 Shaded areas show 95% uncertainty intervals.
 GBD=Global Burden of Diseases, Injuries, and Risk Factors Study.
 SDI=Socio-demographic Index.
 YLLs=years of life lost.

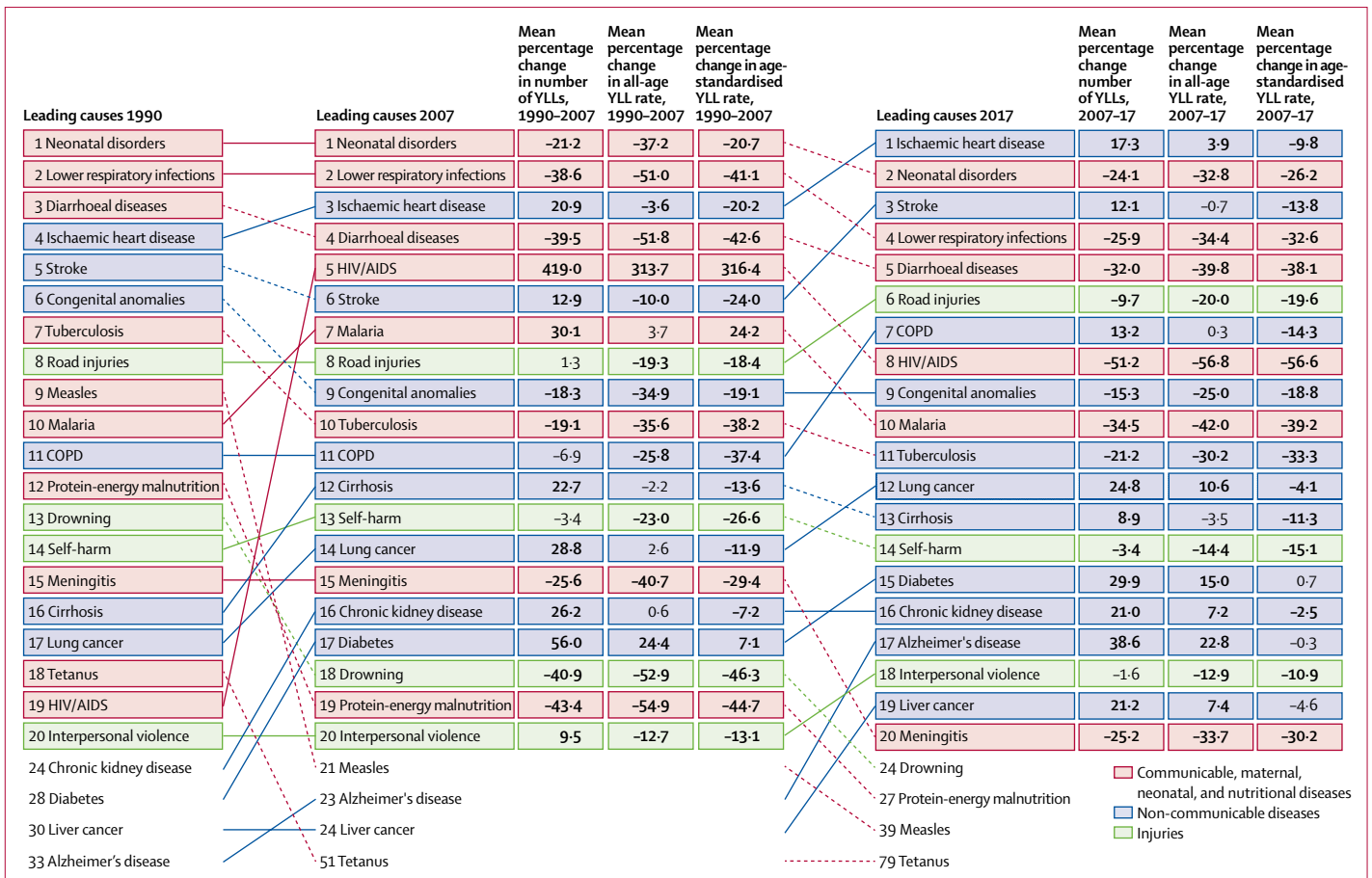


Figure 7: Leading 20 Level 3 causes of global YLLs for 1990, 2007, and 2017 with percentage change in number of YLLs, in all-age and age-standardised rates for both sexes combined Causes are connected by lines between time periods; solid lines are increases and dashed lines are decreases. For the time period 1990-2007 and for 2007-17, three measures of change are shown: percentage change in the number of YLLs, percentage change in the all-age YLL rate, and percentage change in the age-standardised YLL rate. Communicable, maternal, neonatal, and nutritional diseases are shown in red, non-communicable causes in blue, and injuries in green. Statistically significant changes are shown in bold. COPD=chronic obstructive pulmonary disease. YLLs=years of life lost.

interventions. Injury-related death rates have continued to decline since 1990.

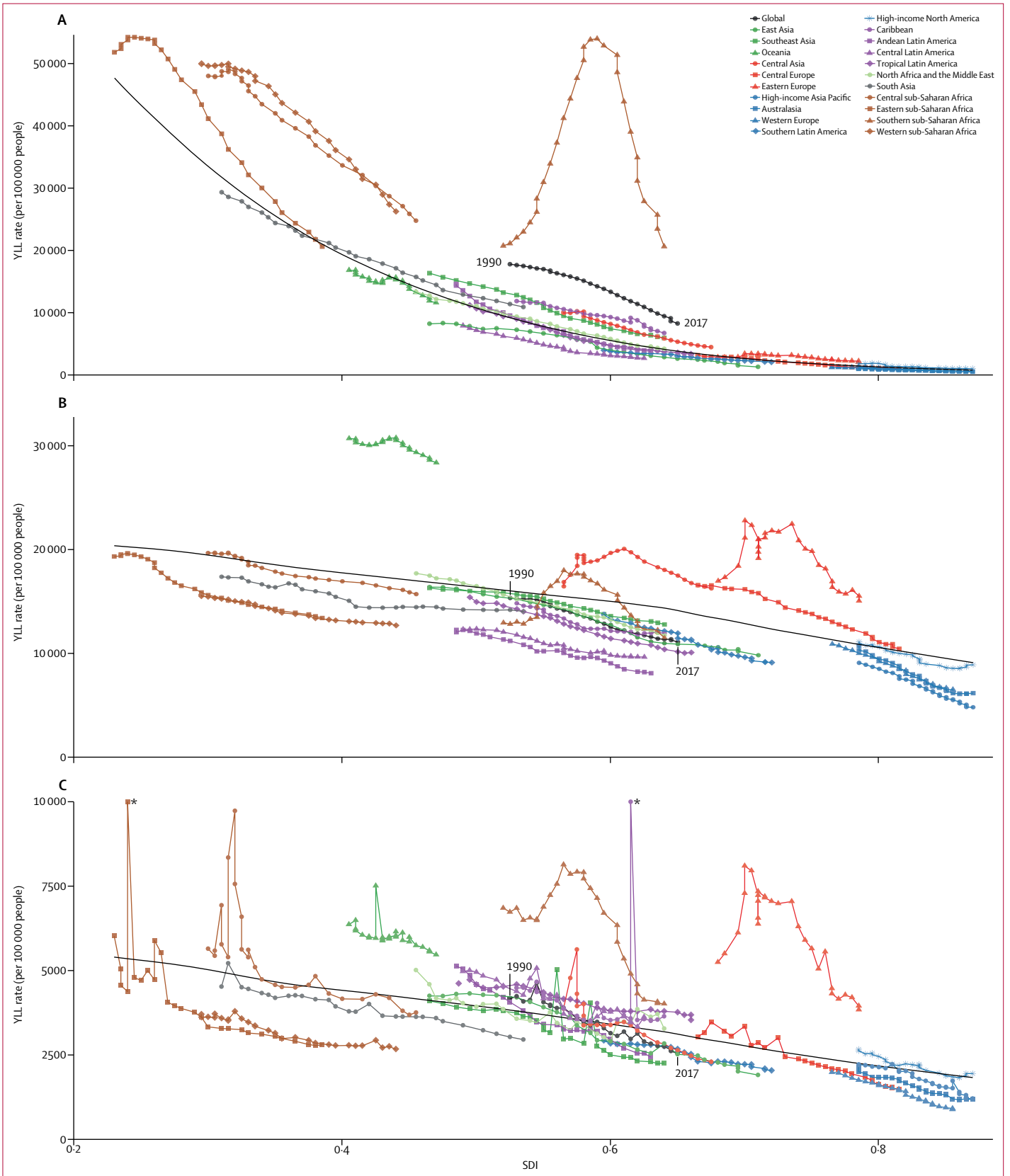
Diseases of obesity

Our results show that a large number of deaths are known to be caused by high body-mass index, including cardiovascular diseases, neoplasms, dementia, asthma, hepatobiliary diseases, as well as diabetes and kidney diseases.²³ The prevalence of obesity continues to rise in almost every country in the world, with more than 1 million deaths estimated as being due to type 2 diabetes, half a million deaths due to diabetes-related chronic kidney disease, and 180000 due to NASH-related liver cancer and cirrhosis in this analysis.²⁴ NASH is most often due to chronic insulin resistance secondary to obesity and might be present among 10-35% of the global adult population.²⁵ The increasing prevalence of obesity might explain why death rates for cardiovascular disease are no longer declining in Australia, Austria, Brazil, Germany, Netherlands, the UK, and the USA.²⁶ There is concern that global rates of ischaemic heart disease and ischaemic

stroke might begin to rise for the first time since the 1970s.²⁷ Increasing obesity could be the result of increased national wealth leading to complex changes in food systems, food quality, nutrition, technology, and levels of physical activity.²⁸ Adult obesity has been identified as a key challenge to global nutrition, in particular for locations where malnutrition and obesity co-occur.²⁹ Evidence-based nutrition policies should address this double burden, including in countries where obesity prevalence is low but estimated to be increasing.²⁴ At the same time, cost-effective therapies that lower elevated blood pressure, cholesterol, and glucose, and reductions in tobacco smoking will remain important interventions.

Lower respiratory and enteric infections

Given the UN General Assembly High-level Meeting on tuberculosis in September, 2018, it is notable that total deaths due to tuberculosis have decreased since 2007, falling most rapidly for children younger than 5 years, but also that the majority of tuberculosis deaths were due to drug-susceptible tuberculosis (88.2% [95% UI 81.4-93.3])



of total tuberculosis deaths in 2017). Deaths due to other lower respiratory infections remain a greater concern for children younger than 5 years due to a mortality rate more than ten times higher than that of tuberculosis.

Pneumococcal pneumonia was estimated to be the leading cause of death due to LRI in 2017 for children younger than 5 years, followed by respiratory syncytial virus pneumonia, *H influenzae* type B pneumonia, and influenza (appendix 2). Although the GBD counterfactual methodology for causes of death does smooth over some epidemics, our results show that over the past 27 years, mortality due to influenza and pneumococcal pneumonia has decreased but not at the same rate, reflecting differences in the age patterns and vaccination trends during this time period.³⁰ Declines in other vaccine-preventable causes of child mortality, such as measles, suggest that achievements are possible over short periods of time.

Reductions in deaths due to pneumonia between 1990 and 2017 have been far larger for children than for older adults, with death rates due to pneumococcal pneumonia in adults older than 70 years having fallen by less than half as much as those of children, while death rates due to influenza and respiratory syncytial virus pneumonia have changed only minimally (appendix 2).

Similar patterns are seen for deaths due to enteric infections. Deaths related to *C difficile* increased among older adults, with only moderate declines in deaths due to other infectious causes of diarrhoea, while diarrhoeal deaths for children younger than 5 years continued to decline. The epidemic of *C difficile* might reflect increased incidence and pathogenicity of this bacterium, due to changing patterns of antibiotic resistance, comorbidity, and susceptibility among an ageing adult population.³¹ The age pattern for deaths due to multiple infectious diseases reflects investments in interventions that reduce childhood mortality as well as the challenges of delivering more complex health interventions to older adults with comorbid conditions. Evidence-based health policies will need to consider whether large increases in the use of antibiotics³² are leading to meaningful reductions in adult infections.³³

The geography of conflict

Conflict-related deaths represent the fastest growing cause of injury-related deaths. Since 2007, conflicts have resulted

in 1·14 million deaths, concentrated in the North Africa and Middle East region.³⁴ Parts of South Asia, sub-Saharan Africa, and Latin America are also experiencing increasing rates of conflict-related deaths since 2007. Childhood deaths due to conflict were disproportionate. Regions with ongoing conflict are likely to face recurring health emergencies and present a particular challenge for achieving global development targets.³⁵ Regional efforts to promote public health in areas with ongoing conflict, such as the recently established Africa Centres for Disease Control and Prevention,³⁶ might help to support surveillance and implementation of evidence-based health policies in these often dire situations.

Countervailing patterns

The identification of exceptions to any large-scale patterns is an important result of GBD 2017. There are notable exceptions to the overall pattern of increasing total deaths from NCDs. For example, the total number of deaths from various congenital anomalies, including neural tube defects, congenital heart anomalies, and orofacial clefts decreased during the past decade. Some of the decline in neural tube defects and orofacial clefts could be related to improved nutritional status of women and more widespread introduction of folic acid fortification programmes, and some reductions might also be related to improvements in prenatal screening, access to abortion, supportive and interventional care services for infants born with birth defects, and broader reductions in infectious diseases to which such infants are especially susceptible.³⁷ Conversely, for selected causes, both the number of deaths and death rate are increasing, including opioid, cocaine, amphetamine, and other drug use disorders, and liver cancers due to hepatitis B and hepatitis C. Inadequate access to treatment for hepatitis C, and restricted implementation of risk-prevention and treatment strategies for addiction and substance abuse might explain, in part, why death rates due to these preventable diseases are increasing.³⁸ The total number of fall-related deaths has also risen steadily with no decline in rates, reflecting the way in which population ageing might be having a differential effect on injury-related deaths.

Public health significance

Recent plateaus in mortality rates

The results of GBD 2017 show that declines in death rates of some common diseases are slowing or have ceased, primarily for NCDs. Declines in cardiovascular disease and neoplasms are slowing for many high-income countries. This observation is clearest for estimates at the subnational level, where deaths from these causes are increasing for some states in the USA and local authorities in the UK. Medications that lower blood pressure and blood cholesterol, and therefore the risk of atherosclerotic vascular disease events and deaths, are among the most cost-effective interventions available to health systems but are not being delivered effectively.

Figure 8: Co-evolution of age-standardised YLLs with SDI globally and for GBD regions for Level 1 causes, for both sexes combined, 1990–2017

(A) Communicable, maternal, neonatal, and nutritional diseases. (B) Non-communicable diseases. (C) Injuries. Coloured lines show global and region values for YLL rates. Each point in a line represents one year starting at 1990 and ending at 2017. In all regions, SDI has increased over time so progress in SDI is associated with points further to the right and later years for a given region. The black lines indicate expected trajectories for each geography expected on the basis of SDI alone. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. SDI=Socio-demographic Index. YLLs=years of life lost. *Values denoted by asterisks are 18 926·3 for eastern sub-Saharan Africa in 1994 and 35 078·7 for the Caribbean in 2010.

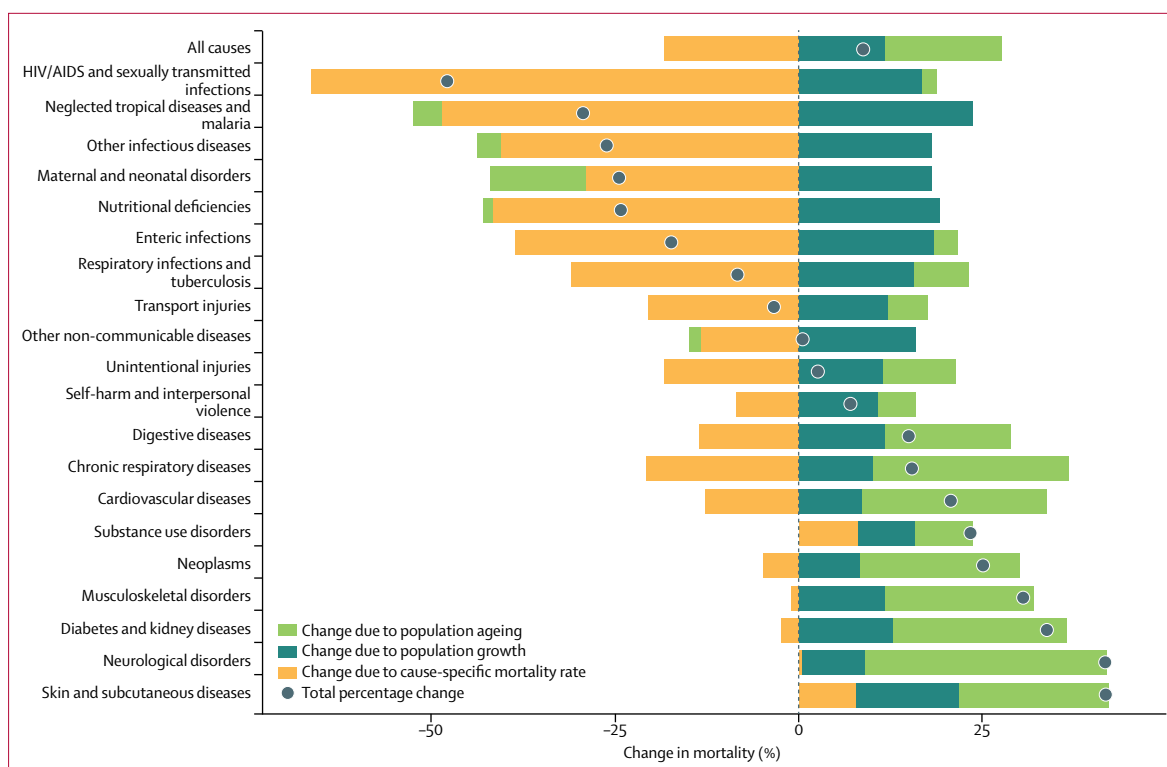


Figure 9: Percentage change in all-age mortality by Level 2 causes at the global level from 2007 to 2017, due to population growth, population ageing, and cause-specific mortality

Mental disorders, for which there were 272 deaths globally in 2007 and 327 deaths globally in 2017, are not shown separately but are included in the all-cause category.

Increasing evidence of a plateau in the decline, or even increases, in atherosclerotic vascular diseases should drive investment towards innovative systems that can effectively deliver these medications as well as public health measures and behaviour changes that need to accompany them.³⁹ Plateaus in mortality are not restricted to high-income countries and can also be seen for leading causes in low-income countries. Decreases in the death rate of malaria have slowed for many regions, perhaps related to a period of slowing in the decline in incident infections observed in many regions between 2011 and 2013. Improved malaria mortality surveillance will be required to understand these most recent patterns.

Beyond the leading causes of death

Some common causes of death receive relatively less attention from the global community, because of their position as second or lower-ranked causes within a larger category. These highly ranked but non-leading causes include stomach cancer, asthma, syphilis, chronic kidney disease, congenital heart disease, and rheumatic heart disease. These causes combined resulted in more than 3 million deaths in 2017. Deaths due to these causes are at least partially amenable to primary or secondary prevention strategies, suggesting that improvements in the continuum of care, including in food quality, sanitation, diagnosis and screening, ongoing case

management, and increased access to essential medicines via expanded universal health coverage, will have an important role in their reduction.⁴⁰ GBD 2017 added several important but less heralded causes of death, including liver cancer due to NASH, subarachnoid haemorrhage, and non-rheumatic valvular heart diseases. These diseases sometimes do not have the more easily addressed risk exposures associated with the leading causes of death such as LRI, HIV/AIDS, lung cancer, or ischaemic heart disease, or they might be prevalent in locations where medical technologies or effective health-care interventions are less widely available. Diseases ranked lower within a larger cause category also might not benefit from the large-scale, focused advocacy efforts for the leading causes of death yet represent important future targets for research and public health. A rational, disease-burden-based approach to priority setting for health policy, now being adopted in some countries,⁴¹ might help to accelerate the scale-up of interventions that will have the largest impact on disability and premature death.

Emerging diseases and disorders due to antibiotic and opioid use

Although GBD provides estimates starting in the year 1980, changes in the most recent years are of particular importance for governments working to improve responsiveness to emerging threats to human health.

Since 2007, rapid increases in death rates have been observed for a small number of diseases and disorders, including dengue, extensively drug-resistant tuberculosis, cellulitis, *C difficile* diarrhoea, and opioid, cocaine, and amphetamine use disorders. Of the infectious causes (other than dengue, the increase of which might reflect changes in the range of its primary vector, *Aedes aegypti*), increased pathogenicity due to antibiotic use or resistance is likely to be a major factor. Rapid increases in opioid-related deaths, particularly in the USA and Canada⁴² but also in other high SDI locations,⁴³ have been attributed in part to wider availability of high-potency opioid analgesics⁴⁴ and to international illegal trade of synthetic opioids.⁴⁵

These emerging causes are associated with wider use of pharmaceuticals. The global health armamentarium will need to expand beyond its traditional approach of increasing access to treatment to include antimicrobial stewardship⁴⁶ and programmes to manage the use of synthetic opioids. Policy makers will need particular expertise to balance these initiatives with equally vocal calls to address sepsis⁴⁷ and cancer pain^{48,49} as global health priorities.

Epidemiological transition for injuries and cancer

The epidemiological transition is most commonly thought of as a decline in CMNN deaths and a rise in chronic NCDs. GBD 2017 shows that deaths due to injuries and cancers also undergo characteristic transitions. Although specific locations have substantial spikes in injury-related mortality during natural disasters or conflicts, the mortality rates from specific injuries can vary as a function of development along the SDI spectrum. Road injuries, for example, might initially increase early in development when more of the population has exposure to transport-related injuries. As development increases, however, it becomes increasingly important for countries to invest in specific resources that can protect against mortality from these injuries, such as advanced trauma care, emergency medical response, vehicle safety initiatives such as seatbelt laws, and interventions to reduce distractions while driving.⁵⁰

By contrast, other injuries such as falls and self-harm might more reliably decline as SDI increases and access to medical care improves. For example, deaths related to self-harm have declined drastically throughout China, possibly because of improved economic prospects among the poorest individuals and decreased access to lethal pesticides.⁵¹ There are also exceptions where deaths related to self-harm are not declining, including Australia, Brazil, the Philippines, Turkey, and the USA. Further research is needed to fully examine the underlying factors driving these divergent trends.

The epidemiological transition can also be observed among the different types of cancer. In many countries with lower SDI, cancers of infectious aetiology⁵² or related to poor nutrition are decreasing, whereas cancers typically

associated with obesity and alcohol consumption are becoming more common. The concept that future demands on health systems might be, at least in part, predictable is an attractive feature of the theory of epidemiological transition that merits further exploration, such as recent work to produce health forecasts using results of the GBD study and projections of SDI.⁵³

Continuous quality improvement

GBD 2017 has developed new methods to address the observation that some common causes of death are reported by surveillance systems as having implausible trends across time and varying widely between countries.^{54,55} This concern has been noted for dementia and Parkinson's disease, where there has been a rapid rise in reported deaths attributed to these causes despite stable incidence and case fatality in most epidemiological studies.^{56–60} A new analysis by GBD 2017 uses 35 years of person-level underlying and intermediate cause of death data from the USA—a database of 80·4 million deaths—to better understand how physicians are choosing from a range of alternative diseases when selecting an underlying cause of death that was actually dementia. Countries should consider better use of important contextual data already being collected, such as intermediate and immediate causes of death, to improve the stability and robustness of their mortality surveillance systems. Both New Zealand and Brazil have already made intermediate cause of death data available for this kind of analysis, and other countries should consider this low-cost, high-impact path in the future.

Changes in health estimates between GBD 2016 and GBD 2017

Each iteration of GBD re-analyses the entire time series by use of newly available data sources from across all estimation years and continually improved methods. New data and modelling approaches effectively improve model validity and decrease uncertainty from various sources with the consequence that estimates for a given cause, location, and year might differ between GBD iterations. The magnitude of these differences between GBD 2017 and GBD 2016 is presented in figure 1. Below we discuss some specific data and methodology changes underlying distinct differences in estimation.

A novel, integrated demographic assessment of population, fertility, and all-cause mortality was completed for GBD 2017. This development affected all causes because of the inclusion of population estimates in age-sex splitting algorithms, but most directly affected maternal and HIV/AIDS-related mortality estimates. The GBD 2017 assessment of the proportion of all-cause deaths due to maternal and neonatal disorders (3·7% [95% UI 3·5–3·8]) was similar to that of GBD 2016 (3·6% [3·4–3·8]), with the difference largely due to addition of new data and expanded subnational estimation. Additionally, GBD 2017 combined maternal and neonatal conditions as a category at Level 2 of

the cause hierarchy; as a result, causes within this grouping are now separately reported at Level 3 (rather than Level 2), with neonatal conditions appearing for the first time as the second most common Level 3 source of YLLs.

Access to additional data sources led to several differences in estimation, including the addition of 2778 deaths in children younger than 5 years attributable to the inclusion of additional VA data for Nigeria⁶¹—a high-population, high-burden location—in GBD 2017. Similarly, introduction of these new data resulted in a decrease in estimated mortality from malaria, so that the GBD 2017 estimate for the year 2016 included 78 200 fewer deaths for Nigeria than were estimated by GBD 2016 for that year.

GBD 2017 also included an additional 502 country-years of cancer registry data and 127 country-years of VR system data compared with GBD 2016; 49·6% of the new cancer registry data came from the newly released Cancer Incidence in Five Continents (CI5 XI) database.⁶²

For GBD 2017, major changes to the modelling strategy for dementia and Parkinson's disease included reallocating deaths from causes identified in multiple cause of death data in the USA as the likely alternative cause of death if dementia had not been assigned as the underlying cause. This approach allowed for more accurate identification of deaths to be reassigned to dementia and Parkinson's disease, including a sizeable proportion that had been assigned to garbage code categories as well as common, more specific causes of death in people with dementia or Parkinson's disease.

Changes in data sources and methods have led to improved estimates for several causes. Comparing the most recent decade between GBD 2016 and GBD 2017, 2006 to 2016, the estimated increase in deaths from drug use disorders in GBD 2017 (55·9% [95% UI 53·1–58·8]) was greater than the estimated increase for the same period in GBD 2016 (15·2% [4·8–26·4]), driven by a better fit to most recent years of data in the USA and the use of more appropriate covariates, including sales of prescription opioids by country and the prevalence of injecting drug use. Estimates of HIV/AIDS deaths among children in 2016 were higher in GBD 2017 (84 500 deaths [75 800–94 200]) than those (61 700 deaths [56 000–68 000]) estimated by GBD 2016 for the same year. In countries with high-quality VR data, child incidence was adjusted to produce mortality estimates that better align with recorded HIV/AIDS deaths. Additionally, the paediatric HIV/AIDS mortality estimates were produced with the CD4-count-specific mortality and progression parameters developed by UNAIDS.⁶³

Comparison of GBD 2017 to other estimates

The primary comparison dataset for malaria is the World Malaria Report (WMR)⁶⁴ produced by WHO. As the Malaria Atlas Project produces results for both GBD and the many countries in the WMR, it is not surprising that these results align closely. WHO hepatitis estimates for 2015 present combined mortality results for different

stages of viral hepatitis infection (acute hepatitis, cirrhosis, and liver cancer), but the methods and data sources used to generate these estimates are incompletely described;⁶⁵ at least some results were based on additional modelling of GBD 2013 results. Total deaths were estimated at 1·34 million by WHO in 2015, compared with 1·07 million (95% UI 1·02–1·11) for the same year in the present analysis (139 000 deaths [116 000–158 000] for acute hepatitis, 306 000 deaths [281 000–305 000] for hepatitis B cirrhosis, 165 000 deaths [159 000–172 000] for hepatitis B liver cancer, 294 000 deaths [268 000–319 000] for hepatitis C cirrhosis, and 165 000 deaths [159 000–172 000] for hepatitis C liver cancer).

The estimates from the WHO Maternal Child Epidemiology Estimation (MCEE) for cause-specific under-5 mortality in 2016 at the global level differ from those produced by GBD 2017. Notable differences include the absence of estimates for haemoglobinopathies by WHO-MCEE and estimates of deaths from congenital anomalies (303 000 deaths) that are lower than those estimated by GBD (516 000 deaths [95% UI 446 000–595 000]). Lower congenital estimates are primarily due to inclusion of VA studies by WHO-MCEE that were assessed for GBD but found to be unreliable and implausibly low, as described above.⁶⁶ The number of LRI deaths estimated by GBD 2017 for children younger than 5 years (828 000 deaths [774 000–884 000]) was smaller globally than the number estimated by the MCEE group (920 000 deaths in 2015), with the main differences in India and Pakistan. GBD uses the sample registration system by Indian state, whereas the MCEE group uses the Million Deaths Study and the INDEPTH network mortality data,⁶⁶ driving much of the difference between those estimates and those from the present study. Iuliano and colleagues⁶⁷ recently estimated 290 000–650 000 seasonal influenza-associated respiratory deaths globally. Differences in modelling strategy and underlying premise account for much of the difference in that estimate from those of the present study. Chiefly, the estimate of Iuliano and colleagues accounts for any deaths that potentially could be associated with influenza, whereas the GBD 2017 approach estimates only LRI deaths attributable to influenza within the GBD counterfactual framework. The UN Maternal Mortality Estimation Inter-Agency Group (MMEIG) has not updated its estimates since 2015.⁶⁸

The Globocan project, led by the International Agency for Research on Cancer (IARC),⁶⁹ provides estimates of the global and national-level cancer burden for 2012. Whereas Globocan only estimates cancer mortality for a single year, GBD provides mortality estimates for all diseases over time, including for selected subnational locations. This approach allows GBD to account for unknown causes of death by redistributing these to the most likely underlying cause—including cancer. To estimate cancer mortality, six different methods are used in Globocan. In GBD, cancer mortality was estimated with a single ensemble model approach. Despite these differences, estimates at

the global level were similar, with Globocan estimating 8·2 million cancer deaths and GBD estimating 8·38 million (95% UI 8·26–8·48) for the year 2012 (appendix 2).

GBD 2017 estimates of deaths from all cardiovascular diseases were generally similar to WHO estimates from recent years. Non-GBD estimates for specific cardiovascular diseases are less common. A recent study estimating global and national deaths due to alcoholic cardiomyopathy used a model based on all-cause mortality and alcohol-attributable fractions.⁷⁰ The investigators estimated 25 997 deaths (95% CI 17 358–49 096) in 2015 compared with GBD 2017 estimates of 90 700 (95% UI 82 800–97 500). Higher GBD estimates are the result of the garbage code redistribution method used by GBD, although the geographical distribution of deaths by country is similar for both studies. In GBD, a substantial number of garbage-coded deaths (eg, heart failure, senility, and atherosclerosis) are redistributed to cardiovascular disease causes, including ischaemic heart disease and alcoholic cardiomyopathy.

In this iteration, we estimated that 136 000 deaths were from drug use disorders globally in 2015; by contrast, the 2017 World Drug Report by the UN Office on Drugs and Crime (UNODC) estimated a total of 191 000 drug-attributable deaths in 2015. Differences might reflect the fact that UNODC data are reported directly by member states and the definition of drug-related deaths differs between countries; some countries include overdose deaths, whereas others can include deaths for which drug use was considered to be a contributing factor.

A direct comparison on a global level is possible for selected injuries and locations. Globally, WHO estimated 1·25 million road traffic deaths in 2013,⁷¹ a lower figure than that of GBD 2017, which estimated 1·32 million (95% UI 1·29–1·36) road traffic deaths for the year 2013. Although this difference might be partly due to different modelling strategies, the relatively lower estimate was also present in locations with reliable VR data—for example, for the USA, WHO estimated 34 064 deaths for 2013, whereas the GBD 2017 study estimated 41 600 deaths (39 800–43 000). These differences might also be partly due to modelling differences from internal consistency requirements in the GBD framework, as well as differences in ICD mapping to the underlying cause of death. Our estimate of 645 000 deaths (559 000–679 000) globally due to falls was only slightly lower than WHO's estimate for 2015 of 646 000 deaths,⁷² and a similar difference was present for estimates of deaths from self-harm,⁷³ with WHO estimating approximately 800 000 deaths annually in recent years and GBD estimating approximately 800 000–820 000 deaths annually in recent years.

Limitations

Limitations remain in GBD 2017 despite advances in methodology that addressed some of the difficulties of

estimating cause-specific mortality at global, regional, national, and subnational scales. Limitations that primarily affect specific causes—such as identification of covariates to address the non-linearity in the association between some injuries and the SDI or accounting for changes in awareness of NASH as an explanation for estimated increased mortality—are described in detail in appendix 1 (section 3). Here, we identify limitations with applicability across many causes. First, time lags in available data, absence of data from specific regions, age groups, or time periods, or unreliability in the data that are available—as is the case for malaria estimation, where a key limitation is the rare and punctuated nature of nationally representative surveys of parasite rate; or diarrhoea mortality estimation, where data are restricted among adults and for the geographical areas with the highest mortality levels—can affect the precision of estimations. Second, the accuracy with which underlying cause of death is assigned is a key limitation for both VR data and VA data sources, which is complicated by multimorbidity at the time of death. GBD 2017 makes substantial efforts to enhance the comparability of results by applying corrections for under-registration and garbage code redistribution algorithms. Levels or estimated time trends might still be affected by systematic problems in selected locations. Third, to separately estimate type 1 and type 2 diabetes we used a regression method to redistribute unspecified diabetes deaths on the basis of the specified type 1 and type 2 deaths. As the proportion of unspecified deaths is high, even in many good-quality VR systems, the type-specific estimates are more uncertain. An additional complication is that many excess deaths in people with diabetes are preferentially coded to macrovascular complications such as stroke and ischaemic heart disease. This approach leaves the more direct consequences of diabetes such as ketoacidosis or hyperosmolar coma as reasons to code a death to diabetes as the underlying cause. These complications can affect type 1 and type 2 diabetes differently. Ascertaining the correct proportions of diabetes deaths that should be assigned to type 1 or type 2 diabetes is difficult. Fourth, the percentage of well certified data is a useful indicator of data completeness; however, quality or accuracy in cause of death certification is not necessarily indicated by a low level of identified garbage coding for a given location. Fifth, some sources of uncertainty will not have been captured by the GBD 2017 estimation process, including among the covariates used in models. Sixth, although some causes use negative binomial modelling approaches to improve estimation with overdispersed data, we have not yet developed a standardised empirical approach for selecting causes to use this method. Seventh, the ICD coding convention does not distinguish between suicide and deaths associated with self-harm, and thus our estimate includes both intentional and unintentional self-harm. Finally, because GBD results are a combination of data and estimation, lags in data reporting mean that estimates for the most

recent years rely more on the modelling process, as do estimates for locations with low levels of data completeness. However, for causes with scarce data, the provision of an estimate with an adequate measure of uncertainty is preferable to no information, and identification of these causes is an important step in improving the certification of deaths globally.

Future directions

Re-estimation of the entire GBD mortality time series from 1980 onwards as part of the GBD annual cycle offers multiple opportunities for strengthening global health estimates. This kind of continuous quality improvement²⁴ remains a hallmark of GBD. However, the task of informing national and global policy responses to changing mortality patterns is still reliant on cause of death information that in many cases remains sparse or outdated. The improvements in estimation methods represented in each iteration of GBD do not mitigate the pressing need for investments in data and surveillance on a global scale.

Further work is needed to address the misclassification that occurs in VR data. For example, multiple death codes can be assigned for drug overdoses, and these coding and attribution issues can vary across countries. Additional work is needed to understand the impact of rapid diagnostic testing on the GBD malaria model. Better approaches are needed to make use of location, age, and time patterns when assigning deaths where the disease subtype remains unspecified, such as for diabetes and stroke. More specific subtypes will need to be added for other conditions, such as vascular dementia, breast cancer, and lung cancer. Multiple cause of death data should be put to wider use. Information about intermediate causes of death can be used to improve estimation of disorders that exist as final common pathways to death, including sepsis, heart failure, and acute kidney injury. Multiple cause of death data might also better inform maternal and neonatal death estimates, especially if combined models can borrow strength across related conditions. Associations between inborn and congenital diseases, developmental disorders, and infectious or malnutrition-related deaths are also likely. Additional data about maternal exposures, including tobacco, air pollution, alcohol, and obesity, could lead to cause-specific mortality estimates among newborn babies.

An important goal of the GBD collaboration is the production of estimates for increasingly granular locations, down to areas as small as a 5×5 km grid. Estimates of diarrhoea, LRI, and tuberculosis mortality would all have greater impact if produced with a higher degree of geographical precision. Ascertaining the location of injury for causes such as road injuries, falls, drowning, and fires is also an important goal and could improve understanding of where investments in civil infrastructure might most benefit the population. Injury models could also make use of satellite and other open

data sources to incorporate more information about the presence and use of improved roads, use of seatbelts, or availability of firearms.

Conclusion

GBD 2017 reveals both long-term and more recent patterns in global health. The number of deaths due to communicable, maternal, neonatal, and nutritional causes continues to decline, although at varying rates, whereas the number of deaths from NCDs is increasing and those from injuries remains stable. There is evidence that previously observed declines in death rates of some common diseases are now either slowing or have ceased, primarily for NCDs. Mortality estimates are being made with increasing detail as a result of improved methods for correcting biases in the data and the addition of new data sources, new causes, and new subnational locations. The GBD collaboration has expanded to include experts from 140 countries, with formal government engagement leading to the production of subnational estimates. Investments are being made to extend the reach of high-quality mortality surveillance and VR. SDG targets tied to mortality rates will be able to use annual GBD results to benchmark progress and identify best practices in every country.

GBD 2017 Causes of Death Collaborators

Gregory A Roth, Degu Abate, Kalkidan Hassen Abate, Solomon M Abay, Cristiana Abbafati, Nooshin Abbasi, Hedayat Abbastabar, Foad Abd-Allah, Jemal Abdela, Ahmed Abdelalim, Ibrahim Abdollahpour, Rizwan Suliankatchi Abdulkader, Haftom Temesgen Abebe, Molla Abebe, Zegeye Abebe, Ayenew Negesse Abejic, Semaw F Abera, Olifan Zewdie Abil, Haftom Niguse Abraha, Akililu Roba Abraham, Laith Jamal Abu-Raddad, Manfred Mario Kokou Accrombessi, Dilaram Acharya, Abdu A Adamu, Oladimeji M Adebayo, Rufus Adesoji Adedoyin, Victor Adekanmbi, Olatunji O Adetokunboh, Beyene Meressa Adhena, Mina G Adib, Amha Admasie, Ashkan Afshin, Gina Agarwal, Kareha M Aagesa, Anurag Agrawal, Sutapa Agrawal, Alireza Ahmadi, Mehdi Ahmadi, Muktar Beshir Ahmed, Sayem Ahmed, Amani Nidhal Aichour, Ibtihel Aichour, Miloud Taki Eddine Aichour, Mohammad Esmaeil Akbari, Rufus Olusola Akinyemi, Nadia Akseer, Ziyad Al-Aly, Ayman Al-Eyadhy, Rajaa M Al-Raddadi, Fares Alahdab, Khurshid Alam, Tahiya Alam, Animum Alebel, Kefyalew Addis Alene, Mehran Alijanzadeh, Reza Alizadeh-Navaei, Syed Mohamed Aljunid, Ala'a Alkerwi, François Alla, Peter Allebeck, Jordi Alonso, Khalid Altirkawi, Nelson Alvis-Guzman, Azmeraw T Amare, Leopold N Aminde, Erfan Amini, Walid Ammar, Yaw Ampem Amoako, Nahla Hamed Anber, Catalina Liliana Andrei, Sofia Androudi, Megbaru Debalkie Animum, Mina Anjomshoa, Hossein Ansari, Mustafa Geleto Ansha, Carl Abelardo T Antonio, Palwasha Anwari, Olatunde Aremu, Johan Årnlöv, Amit Arora, Monika Arora, Al Artaman, Krishna K Aryal, Hamid Asayesh, Ephrem Tsegay Asfaw, Zerihun Ataro, Suleman Atique, Sachin R Atre, Marcel Ausloos, Euripide F G A Avokpaho, Ashish Awasthi, Beatriz Paulina Ayala Quintanilla, Yohanes Ayele, Rakesh Ayer, Peter S Azzopardi, Arefeh Babazadeh, Umar Bacha, Hamid Badali, Alaa Badawi, Ayele Geleto Bali, Katherine E Ballesteros, Maciej Banach, Kajori Banerjee, Marlena S Bannick, Joseph Adel Mattar Banoub, Miguel A Barboza, Suzanne Lyn Barker-Collo, Till Winfried Bärnighausen, Simon Barquera, Lope H Barrero, Quique Bassat, Sanjay Basu, Bernhard T Baune, Habtamu Wondifraw Baynes, Shahrzad Bazargan-Hejazi, Neeraj Bedi, Ettore Beghi, Masoud Behzadifar, Meysam Behzadifar, Yannick Béjot, Bayu Begashaw Bekele, Abate Bekele Belachew, Ezra Belay, Yihalem Abebe Belay, Michelle L Bell, Aminu K Bello, Derrick A Bennett, Isabela M Bensenor, Adam E Berman, Eduardo Bernabe,

Robert S Bernstein, Gregory J Bertolacci, Mircea Beuran, Tina Beyranvand, Ashish Bhalla, Suraj Bhattarai, Soumyadeep Bhaumik, Zulfiqar A Bhutta, Belete Biadgo, Molly H Biehl, Ali Bijani, Boris Bikbov, Ver Bilano, Nigus Bililign, Muhammad Shahdaat Bin Sayeed, Donal Bisanzio, Tuhin Biswas, Brigitte F Blacker, Berrak Bora Basara, Rohan Borschmann, Cristina Bosetti, Kayvan Bozorgmehr, Oliver J Brady, Luisa C Brant, Carol Brayne, Alexandra Brazinova, Nicholas J K Breitborde, Hermann Brenner, Paul Svitil Briant, Gabrielle Britton, Traolach Brugha, Reinhard Busse, Zahid A Butt, Charlton S K H Callender, Ismael R Campos-Nonato, Julio Cesar Campuzano Rincon, Jorge Cano, Mate Car, Rosario Cárdenas, Giulia Carreras, Juan J Carrero, Austin Carter, Félix Carvalho, Carlos A Castañeda-Orjuela, Jacqueline Castillo Rivas, Chris D Castle, Clara Castro, Franz Castro, Ferrán Catalá-López, Ester Cerin, Yazan Chaiah, Jung-Chen Chang, Fiona J Charlson, Pankaj Chaturvedi, Peggy Pei-Chia Chiang, Odgerel Chimed-Ochir, Vesper Hichilombwe Chisumpa, Abdulaal Chitheer, Rajiv Chowdhury, Hanne Christensen, Devasahayam J Christopher, Sheng-Chia Chung, Flavia M Cicuttini, Liliana G Ciobanu, Massimo Cirillo, Aaron J Cohen, Leslie Trumbull Cooper, Paolo Angelo Cortesi, Monica Cortinovic, Ewerton Cousin, Benjamin C Cowie, Michael H Criqui, Elizabeth A Cromwell, Christopher Stephen Crowe, John A Crump, Matthew Cunningham, Alemneh Kabeta Daba, Abel Fekadu Dadi, Lalit Dandona, Rakhi Dandona, Anh Kim Dang, Paul I Dargan, Ahmad Daryani, Siddharth K Das, Rajat Das Gupta, José Das Neves, Tamirat Tesfaye Dasa, Aditya Prasad Dash, Adrian C Davis, Nicole Davis Weaver, Dragos Virgil Davitoui, Kairat Davletov, Fernando Pio De La Hoz, Jan-Walter De Neve, Meaza Girma Degefa, Louisa Degenhardt, Tizta T Degfie, Selina Deiparine, Gebre Teklemariam Demoz, Balem Betsu Demtsu, Edgar Denova-Gutiérrez, Kebede Deribe, Nikolaos Dervenisi, Don C Des Jarlais, Getenet Ayalew Dessie, Subhjit Dey, Samath D Dharmaratne, Daniel Dicker, Mesfin Tadesse Dinberu, Eric L Ding, M Ashworth Dirac, Shirin Djalalinia, Klara Dokova, David Teye Doku, Christl A Donnelly, E Ray Dorsey, Pratik P Doshi, Dirk Douwes-Schultz, Kerrie E Doyle, Tim R Driscoll, Manisha Dubey, Eleonora Dubljanin, Eyasu Ejeta Duken, Bruce B Duncan, Andre R Duraes, Hedyeh Ebrahimi, Soheil Ebrahimipour, Dumessa Edessa, David Edvardsson, Anne Elise Eggen, Charbel El Bcheraoui, Maysaa El Sayed Zaki, Ziad El-Khatib, Hajer Elkout, Christian Lycke Ellingsen, Matthias Endres, Aman Yesuf Endries, Benjamin Er, Holly E Erskine, Babak Eshrati, Sharareh Eskandari, Reza Esmaeili, Alireza Esteghamati, Mahdi Fakhar, Hamed Fakhim, Mahbobeh Faramarzi, Mohammad Fareed, Farzaneh Farhadi, Carla Sofia E sá Farinha, Andre Faro, Maryam S Farvid, Farshad Farzadfar, Mohammad Hosein Farzaei, Valery L Feigin, Andrea B Feigl, Netsanet Fentahun, Seyid-Mohammad Fereshtehnejad, Eduarda Fernandes, Joao C Fernandes, Alize J Ferrari, Garumma Tolu Feyissa, Irina Filip, Samuel Finegold, Florian Fischer, Christina Fitzmaurice, Nataliya A Foigt, Kyle J Foreman, Carla Fornari, Tahvi D Frank, Takeshi Fukumoto, John E Fuller, Nancy Fullman, Thomas Fürst, João M Furtado, Neal D Futran, Silvano Gallus, Alberto L Garcia-Basteiro, Miguel A Garcia-Gordillo, William M Gardner, Abadi Kahu Gebre, Tsegaye Tewelde Gebrehiwot, Amanuel Tesfay Gebremedhin, Bereket Gebremichael, Teklu Gebrehiwo Gebremichael, Tilayie Feto Gelano, Johanna M Geleijnse, Ricard Genova-Maleras, Yihma Chisha Dea Geramo, Peter W Gething, Kebede Embaye Gezae, Mohammad Rasoul Ghadami, Reza Ghadimi, Khalil Ghasemi Falavarjani, Maryam Ghasemi-Kasman, Mamata Ghimire, Katherine B Gibney, Paramjit Singh Gill, Tiffany K Gill, Richard F Gillum, Ibrahim Abdelmageed Ginawi, Maurice Giroud, Giorgia Giussani, Shifalika Goenka, Ellen M Goldberg, Srinivas Goli, Hector Gómez-Dantés, Philimon N Gona, Sameer Vali Gopalani, Taren M Gorman, Atsushi Goto, Alessandra C Goulart, Elena V Gnedovskaya, Ayman Grada, Giuseppe Grosso, Harish Chander Gugnani, Andre Luiz Sena Guimaraes, Yuming Guo, Prakash C Gupta, Rahul Gupta, Rajeev Gupta, Tanush Gupta, Reyna Alma Gutiérrez, Bishal Gyawali, Juanita A Haagsma, Nima Hafezi-Nejad, Tekleberhan B Hagos, Tewodros Tesfa Hailegiyorgis, Gessesew Bugssa Hailu, Arvin Haj-Mirzaian, Arya Haj-Mirzaian, Randa R Hamadeh, Samer Hamidi, Alexis J Handal, Graeme J Hankey, Hilda L Harb, Sivadasanpillai Harikrishnan, Josep Maria Haro, Mehedi Hasan, Hadi Hassankhani, Hamid Yimam Hassen, Rasmus Havmoeller, Roderick J Hay, Simon I Hay, Yihua He, Akbar Hedayatizadeh-Omran, Mohamed I Hegazy, Behzad Heibati, Mohsen Heidari, Delia Hendrie, Andualem Henok, Nathaniel J Henry, Claudiu Herteliu, Fatemeh Heydarpour, Pouria Heydarpour, Sousan Heydarpour, Desalegn Tsegaw Hibstu, Hans W Hoek, Michael K Hole, Enayatollah Homaie Rad, Praveen Hoogar, H Dean Hosgood, Seyed Mostafa Hosseini, Mehdi Hosseinzadeh, Mihaela Hostiu, Sorin Hostiu, Peter J Hotez, Damian G Hoy, Thomas Hsiao, Guoqing Hu, John J Huang, Abdullatif Husseini, Mohammedaman Mama Hussen, Susan Hutfless, Bulat Idrisov, Olayinka Stephen Ilesanmi, Usman Iqbal, Seyed Sina Naghibi Irvani, Caleb Mackay Salpeter Irvine, Nazrul Islam, Sheikh Mohammed Shariful Islam, Farhad Islami, Kathryn H Jacobsen, Leila Jahangiry, Nader Jahanmehr, Sudhir Kumar Jain, Mihajlo Jakovljevic, Moti Tolera Jalu, Spencer L James, Mehdi Javanbakht, Achala Upendra Jayatileke, Panniyammakal Jeemon, Kathy J Jenkins, Ravi Prakash Jha, Vivekanand Jha, Catherine O Johnson, Sarah C Johnson, Jost B Jonas, Ankur Joshi, Jacek Jerzy Jozwiak, Suresh Banayya Jungari, Mikko Jürisson, Zubair Kabir, Rajendra Kadel, Amaha Kabsay, Rizwan Kalani, Manoochehr Karami, Behzad Karami Matin, André Karch, Corine Karema, Hamidreza Karimi-Sari, Amir Kasaean, Dessalegn H Kassa, Getachew Mullu Kassa, Tesfaye Dessale Kassa, Nicholas J Kassebaum, Srinivasa Vittal Katikireddi, Anil Kaul, Zhila Kazemi, Ali Kazemi Karyani, Dhruv Satish Kazi, Adane Teshome Kefale, Peter Njenga Keiyoro, Grant Rodgers Kemp, Andre Pascal Kengne, Andre Keren, Chandrasekharan Nair Kesavachandran, Yousef Saleh Khader, Behzad Khafaei, Morteza Abdullatif Khafaei, Alireza Khajavi, Nauman Khalid, Ibrahim A Khalil, Ejaz Ahmad Khan, Muhammad Shahzeb Khan, Muhammad Ali Khan, Young-Ho Khang, Mona M Khater, Abdullah T Khoja, Ardeshir Khosravi, Mohammad Hossein Khosravi, Jagdish Khubchandani, Aliasghar A Kiadaliri, Getie D Kibret, Zelalem Teklemariam Kidanemariam, Daniel N Kiirithio, Daniel Kim, Young-Eun Kim, Yun Jin Kim, Ruth W Kimokoti, Yohannes Kinfu, Adnan Kisa, Katarzyna Kissimova-Skarbek, Mika Kivimäki, Ann Kristin Skringdo Knudsen, Jonathan M Kocarnik, Sonali Kochhar, Yoshihiro Kokubo, Tufa Kolola, Jacek A Kopec, Parvaiz A Koul, Ai Koyanagi, Michael A Kravchenko, Kewal Krishan, Barthelemy Kuate Defo, Burcu Kucuk Bicer, G Anil Kumar, Manasi Kumar, Pushpendra Kumar, Michael J Kutz, Igor Kuzin, Hmwe Hmwe Kyu, Deepesh P Lad, Sheetal D Lad, Alessandra Lafranconi, Dharmesh Kumar Lal, Ratilal Lalloo, Tea Lallukka, Jennifer O Lam, Faris Hasan Lami, Van C Lansingh, Sonia Lansky, Heidi J Larson, Arman Latifi, Kathryn Mei-Ming Lau, Jeffrey V Lazarus, Georgy Lebedev, Paul H Lee, James Leigh, Mostafa Leili, Cheru Tesema Leshargie, Shanshan Li, Yichong Li, Juan Liang, Lee-Ling Lim, Stephen S Lim, Miteku Andualem Limenih, Shai Linn, Shiwei Liu, Yang Liu, Rakesh Lodha, Chris Lonsdale, Alan D Lopez, Stefan Lorkowski, Paulo A Lotufo, Rafael Lozano, Raimundas Lunevicius, Stefan Ma, Erynn Rachelle King Macarayan, Mark T Mackay, Jennifer H MacLachlan, Emilie R Maddison, Fabiana Madotto, Hassan Magdy Abd El Razek, Mohammed Magdy Abd El Razek, Dhaval P Maghavani, Marek Majdan, Reza Majdzadeh, Azeem Majeed, Reza Malekzadeh, Deborah Carvalho Malta, Ana-Laura Manda, Luiz Garcia Mandarano-Filho, Helena Manguerra, Mohammad Ali Mansournia, Chabila Christopher Mapoma, Dadi Marami, Joemer C Maravilla, Wagner Marcenes, Laurie Marczak, Ashley Marks, Guy B Marks, Gabriel Martinez, Francisco Rogerlândio Martins-Melo, Ira Martopullo, Winfried März, Melvin B Marzan, Joseph R Masci, Benjamin Ballard Massenbourg, Manu Raj Mathur, Prashant Mathur, Richard Matzopoulos, Pallab K Maulik, Mohsen Mazidi, Colm McAlinden, John J McGrath, Martin McKee, Brian J McMahon, Suresh Mehata, Man Mohan Mehndiratta, Ravi Mehrotra, Kala M Mehta, Varshil Mehta,

Tefera C Mekonnen, Addisu Melese, Mulugeta Melku, Peter T N Memiah, Ziad A Memish, Walter Mendoza, Desalegn Tadesse Mengistu, Getnet Mengistu, George A Mensah, Seid Tiku Mereta, Atte Meretoja, Tuomo J Meretoja, Tomislav Mestrovic, Haftay Berhane Mezgebe, Bartosz Miazgowski, Tomasz Miazgowski, Anoushka I Millier, Ted R Miller, Molly Katherine Miller-Petrie, G K Mini, Parvaneh Mirabi, Mojde Mirarefin, Andreea Mirica, Erkin M Mirrakhimov, Awoke Temesgen Misganaw, Habtamu Mitiku, Babak Moazen, Karzan Abdulmuhsin Mohammad, Moslem Mohammadi, Noushin Mohammadifard, Mohammed A Mohammed, Shafiu Mohammed, Viswanathan Mohan, Ali H Mokdad, Mariam Molokhia, Lorenzo Monasta, Ghobad Moradi, Maziar Moradi-Lakeh, Mehdi Moradinazar, Paula Moraga, Lidia Morawska, Ilais Moreno Velásquez, Joana Morgado-Da-Costa, Shane Douglas Morrison, Marilita M Moschos, Simin Mouodi, Seyyed Meysam Mousavi, Kindie Fentahun Muchie, Ulrich Otto Mueller, Satinath Mukhopadhyay, Kate Muller, John Everett Mumford, Jonah Musa, Kamarul Imran Musa, Ghulam Mustafa, Saravanan Muthupandian, Jean B Nachega, Gabriele Nagel, Aliya Naheed, Azin Nahvijou, Gurudatta Naik, Sanjeev Nair, Farid Najafi, Luigi Naldi, Hae Sung Nam, Vinay Nangia, Jobert Richie Nansseu, Bruno Ramos Nascimento, Gopalakrishnan Natarajan, Nahid Neamati, Ionut Negoii, Ruxandra Irina Negoii, Subas Neupane, Charles R J Newton, Frida N Ngalesoni, Josephine W Ngunjiri, Anh Quynh Nguyen, Grant Nguyen, Ha Thu Nguyen, Huong Thanh Nguyen, Long Hoang Nguyen, Minh Nguyen, Trang Huyen Nguyen, Emma Nichols, Dina Nur Anggraini Ningrum, Yirga Legesse Nirayo, Molly R Nixon, Nomonde Noluthungu, Shuhei Nomura, Ole F Norheim, Mehdi Noroozi, Bo Norrving, Jean Jacques Noubiap, Hamid Reza Nouri, Malihe Nourollahpour Shiadeh, Mohammad Reza Nowroozi, Peter S Nyasulu, Christopher M Odell, Richard Ofori-Asenso, Felix Akpojene Ogbo, In-Hwan Oh, Olanrewaju Oladimeji, Andrew T Olagunju, Pedro R Olivares, Helen Elizabeth Olsen, Bolajoko Olubukunola Olusanya, Jacob Olusegun Olusanya, Kanyin L Ong, Sok King Sk Ong, Eyal Oren, Heather M Orpana, Alberto Ortiz, Justin R Ortiz, Stanislav S Otstavnov, Simon Øverland, Mayowa Ojo Owolabi, Raziye Özdemir, Mahesh P A, Rosana Pacella, Smita Pakhale, Abhijit P Pakhare, Amir H Pakpour, Adrian Pana, Songhomitra Panda-Jonas, Jeyaraj Durai Pandian, Andrea Parisi, Eun-Ke Park, Charles D H Parry, Hadi Parsian, Shanti Patel, Sanghamitra Pati, George C Patton, Vishnu Priya Rao Paturi, Katherine R Paulson, Alexandre Pereira, David M Pereira, Norberto Perico, Konrad Pesudovs, Max Petzold, Michael R Phillips, Frédéric B Piel, David M Pigott, Julian David Pillay, Meghdad Pirsaeheb, Farhad Pishgar, Suzanne Polinder, Maarten J Postma, Akram Pourshams, Hossein Poustchi, Ashwini Pujar, Swayam Prakash, Narayan Prasad, Caroline A Purcell, Mostafa Qorbani, Hedley Quintana, D Alex Quistberg, Kirankumar Waman Rade, Amir Radfar, Anwar Rafay, Alireza Rafiei, Fakher Rahim, Kazem Rahimi, Afarin Rahimi-Movaghgar, Mahfuzar Rahman, Mohammad Hifz Ur Rahman, Muhammad Aziz Rahman, Rajesh Kumar Rai, Sasa Rajscik, Usha Ram, Chhabhi Lal Ranabhat, Prabhat Ranjan, Puja C Rao, David Laith Rawaf, Salman Rawaf, Christian Razo-García, K Srinath Reddy, Robert C Reiner, Marissa B Reitsma, Giuseppe Remuzzi, Andre M N Renzaho, Serge Resnikoff, Satar Rezaei, Shahab Rezaeian, Mohammad Sadegh Rezaei, Seyed Mohammad Riahi, Antonio Luiz P Ribeiro, Maria Jesus Rios-Blancas, Kedir Teji Roba, Nicholas L S Roberts, Stephen R Robinson, Leonardo Roeber, Luca Ronfani, Gholamreza Roshandel, Ali Rostami, Dietrich Rothenbacher, Ambuj Roy, Enrico Rubagotti, Perminder S Sachdev, Basema Saddik, Ehsan Sadeghi, Hosein Safari, Mahdi Safdarian, Sare Safi, Saeid Safiri, Rajesh Sagar, Amirhossein Sahebkar, Mohammad Ali Sahraian, Nasir Salam, Joseph S Salama, Payman Salamati, Raphael De Freitas Saldanha, Zikria Saleem, Yahya Salimi, Sundeep Santosh Salvi, Inbal Salz, Evanson Zondani Sambala, Abdallah M Samy, Juan Sanabria, Maria Dolores Sanchez-Niño, Damian Francesco Santomauro, Itamar S Santos, João Vasco Santos, Milena M Santric Milicevic, Bruno Piassi Sao Jose, Abdur Razzaque Sarker, Rodrigo Sarmiento-Suárez, Nizal Sarrafzadegan, Benn Sartorius, Shahabeddin Sarvi, Brijesh Sathian, Maheswar Satpathy, Arundhati R Sawant, Monika Sawhney, Sonia Saxena, Mehdi Sayyah, Elke Schaeffner, Maria Inês Schmidt, Ione J C Schneider, Ben Schöttker, Aletta Elisabeth Schutte, David C Schwebel, Falk Schwendicke, James G Scott, Mario Sekerija, Sadaf G Sepanlou, Edson Serván-Mori, Seyedmojtaba Seyedmousavi, Hosein Shabaninejad, Katya Anne Shackelford, Azadeh Shafieesabet, Mehdi Shahbazi, Amira A Shaheen, Masood Ali Shaikh, Mehran Shams-Beyranvand, Mohammadbagher Shamsi, Morteza Shamsizadeh, Kiomars Sharafi, Mehdi Sharif, Mahdi Sharif-Alhoseini, Rajesh Sharma, Jun Shi, Aziz Sheikh, Peilin Shi, Mekonnen Sisay Shiferaw, Mika Shigematsu, Rahman Shiri, Reza Shirkoobi, Ivy Shiue, Farhad Shokraneh, Mark G Shrimme, Si Si, Soraya Siabani, Tariq J Siddiqi, Inga Dora Sigfusdottir, Rannveig Sigurvinsdottir, Donald H Silberberg, Diego Augusto Santos Silva, João Pedro Silva, Natacha Torres Da Silva, Dayane Gabriele Alves Silveira, Jasvinder A Singh, Narinder Pal Singh, Prashant Kumar Singh, Virendra Singh, Dhirendra Narain Sinha, Karen Sliwa, Mari Smith, Badr Hasan Sobaih, Soheila Sobhani, Eugène Sobngwi, Samir S Soneji, Moslem Soofi, Reed J D Sorensen, Joan B Soriano, Ireneous N Soyiri, Luciano A Sposato, Chandrashekar T Sreeramareddy, Vinay Srinivasan, Jeffrey D Stanaway, Vladimir I Starodubov, Vasiliki Stathopoulou, Dan J Stein, Caitlyn Steiner, Leo G Stewart, Mark A Stokes, Michelle L Subart, Agus Sudaryanto, Mu'awiyah Babale Sufiyan, Patrick John Sur, Ipsita Sutradhar, Bryan L Sykes, P N Sylaja, Dillon O Sylte, Cassandra E I Szoek, Rafael Tabarés-Seisdedos, Takahiro Tabuchi, Santosh Kumar Tadakamadla, Ken Takahashi, Nikhil Tandon, Segen Gebremeskel Tassew, Nuno Taveira, Arash Tehrani-Banihashemi, Tigist Gashaw Tekalign, Merhawi Gebremedhin Tekle, Mohamad-Hani Tlemsah, Omar Tlemsah, Abdullah Sulieaman Terkawi, Manaye Yihune Teshale, Belay Tessema, Gizachew Assefa Tessema, Kavumpurathu Raman Thankappan, Sathish Thirunavukkarasu, Nihal Thomas, Amanda G Thrift, George D Thurston, Binyam Tilahun, Quyen G To, Ruoyan Tobe-Gai, Marcello Tonelli, Roman Topor-Madry, Anna E Torre, Miguel Tortajada-Girbés, Mathilde Touvier, Marcos Roberto Tovani-Palone, Bach Xuan Tran, Khanh Bao Tran, Suryakant Tripathi, Christopher E Troeger, Thomas Clement Truelsen, Nu Thi Truong, Afewerki Gebremeskel Tsadik, Derrick Tsoi, Lorainne Tudor Car, E Murat Tuzcu, Stefanos Tyrovolas, Kingsley N Ukwaja, Irfan Ullah, Eduardo A Undurraga, Rachel L Updike, Muhammad Shariq Usman, Olalekan A Uthman, Selen Begüm Uzun, Muthiah Vaduganathan, Afsane Vaezi, Gaurang Vaidya, Pascual R Valdez, Elena Varavikova, Tommi Juhani Vasankari, Narayanaswamy Venketasubramanian, Santos Villafaina, Francesco S Violante, Sergey Konstantinovich Vladimirov, Vasily Vlassov, Stein Emil Vollset, Theo Vos, Gregory R Wagner, Fasil Shiferaw Wagnew, Yasir Waheed, Mitchell Taylor Wallin, Judd L Walson, Yanping Wang, Yuan-Pang Wang, Molla Mesele Wassie, Elisabete Weiderpass, Robert G Weintraub, Fitsum Weldegebreal, Kidu Gidey Weldegewergs, Andrea Werdecker, Adhena Ayaliew Werkneh, T Eoin West, Ronny Westerman, Harvey A Whiteford, Justyna Widecka, Lauren B Wilner, Shadrach Wilson, Andrea Sylvia Winkler, Charles Shey Wiysonge, Charles D A Wolfe, Shouling Wu, Yun-Chun Wu, Grant M A Wyper, Denis Xavier, Gelin Xu, Simon Yadgir, Ali Yadollahpour, Seyed Hossein Yahyazadeh Jabbari, Bereket Yakob, Lijing L Yan, Yuichiro Yano, Mehdi Yaseri, Yasin Jemal Yasin, Gökulp Kadri Yentür, Alex Yeshaneh, Ebrahim M Yimer, Paul Yip, Biruck Desalegn Yirsaw, Engida Yisma, Naohiro Yonemoto, Gerald Yonga, Seok-Jun Yoon, Marcel Yotebieng, Mustafa Z Younis, Mahmoud Youseffard, Chuanhua Yu, Vesna Zadnik, Zoubida Zaidi, Sojib Bin Zaman, Mohammad Zamani, Zohreh Zare, Ayalew Jewaw Zeleke, Zerihun Menkalew Zenebe, Anthony Lin Zhang, Kai Zhang, Maigeng Zhou, Sanjay Zodepy, Liesl Joanna Zuhlke, Mohsen Naghavi, and Christopher J L Murray.

Affiliations
Division of Cardiology, Department of Medicine (G A Roth MD), Institute for Health Metrics and Evaluation (G A Roth MD, A Afshin MD, K M Agesa BA, T Alam MPH, K E Ballesteros PhD, M S Bannick BS, G J Bertolacci BS, M H Biehl MPH, B F Blacker MPH, P S Briant BS, C S Callender BS, A Carter MPH, C D Castle BS, A J Cohen DSc, E A Cromwell PhD, M Cunningham MSc, Prof L Dandona MD,

Prof R Dandona PhD, N Davis Weaver MPH, Prof L Degenhardt PhD, S Deiparine BA, S D Dharmaratne MD, D Dicker BS, M A Dirac MD, D Douwes-Schultz BSc, C El Bcheraoui PhD, Prof V L Feigin PhD, S Finegold BS, K J Foreman PhD, T D Frank BS, J E Fuller, N Fullman MPH, W M Gardner AB, E M Goldberg MPH, T M Gorman BS, Prof S I Hay FMedSci, Y He MS, N J Henry BS, T Hsiao BS, C M S Irvine BS, S L James MD, C O Johnson PhD, S C Johnson MS, N J Kassebaum MD, G R Kemp BA, I A Khalil MD, J M Kocarnik PhD, M J Kutz BS, H H Kyu PhD, Prof H J Larson PhD, K M Lau BS, Prof S S Lim PhD, Prof A D Lopez PhD, Prof R Lozano PhD, E R Maddison BS, H Manguerra BS, L Marczak PhD, A Marks MA, I Martopullo MPH, A I Millier MPH, M K Miller-Petrie MSc, A T Misganaw PhD, Prof A H Mokdad PhD, J E Mumford BA, K Muller MPH, G Nguyen MPH, M Nguyen BS, E Nichols BA, M R Nixon PhD, E O Nsoesie PhD, C M Odell MPP, H E Olsen MA, K L Ong PhD, K R Paulson BS, D M Pigott DPhil, C A Purcell BA, P C Rao MPH, R C Reiner PhD, M B Reitsma BS, N L S Roberts BS, J S Salama MS, K A Shackelford BA, M Smith MPA, V Srinivasan BA, J D Stanaway PhD, C Steiner MPH, L G Stewart BS, M L Subart BA, P J Sur MPH, D O Sylte BA, A E Torre BS, C E Troeger MPH, D Tsoi BS, R L Updike BA, Prof S E Vollset DrPH, Prof T Vos PhD, Prof H A Whiteford PhD, L B Wilner MPH, S Wilson BS, S Yadgir BS, C Fitzmaurice MD, R J D Sorensen MPH, Prof M Naghavi MD, Prof C J L Murray DPhil, Department of Global Health (F J Charlson PhD, S Kochhar MD, Prof J R Ortiz MD, R J D Sorensen MPH, Prof J L Waldon MD), Division of Plastic Surgery, Department of Surgery (C S Crowe MD, B B Massenbourg MD), Division of Hematology, Department of Medicine (C Fitzmaurice MD), Department of Otolaryngology-Head and Neck Surgery (N D Futran MD), Department of Neurology (R Kalani MD), Department of Medicine (B J McMahon MD, T E West MD), Department of Surgery (S D Morrison MD), Department of Bioinformatics and Medical Education (E O Nsoesie PhD), Department of Health Metrics Sciences (A Afshin MD, E A Cromwell PhD, C El Bcheraoui PhD, Prof S I Hay FMedSci, H H Kyu PhD, Prof H J Larson PhD, Prof S S Lim PhD, A T Misganaw PhD, Prof A H Mokdad PhD, D M Pigott DPhil, R C Reiner PhD, J D Stanaway PhD, Prof S E Vollset DrPH, Prof T Vos PhD, M Zhou PhD, Prof M Naghavi MD, Prof C J L Murray DPhil), University of Washington, Seattle, WA, USA (I Kuzin MPH, Prof E Oren PhD); School of Pharmacy (J Abdelela MSc, Y Ayele MSc, D Edessa MSc, G Mengistu MSc, Prof M S Shiferaw MSc), Department of Pediatrics (A R Abrham MSc), Department of Medical Laboratory Science (Z Ataro MSc, D Marami MSc, Prof H Mitiku MSc), School of Public Health (Prof A G Bali MPH, M G Tekle MPH), School of Nursing and Midwifery (T T Dasa MSc, K T Roba PhD), College of Health and Medical Sciences (Prof Z T Kidanemariam MSc), Haramaya University, Harar, Ethiopia (D Abate MSc, T F Gelano MSc, T Hailegiyorgis MSc, M T Jalu MPH, Prof H Mitiku MSc, T G Tekalign MS, Prof F Weldegebreal MPH); Department of Population and Family Health (Prof K H Abate PhD, A T Gebremedhin MPH), Department of Epidemiology (M B Ahmed MPH, Prof T T Gebrehiwot MPH), Mycobacteriology Research Center (Prof E Duken MSc), Department of Health Education & Behavioral Sciences (Prof G T Feyissa MPH), Department of Environmental Health Sciences and Technology (Prof S Mereta PhD), Jimma University, Jimma, Ethiopia; Department of Pharmacology and Clinical Pharmacy (S M Abay PhD), School of Public Health (K Deribe PhD, Y J Yasin MPH), College of Health Sciences (B Gebremichael MSc), School of Allied Health Sciences (Prof E Yisma MPH), Addis Ababa University, Addis Ababa, Ethiopia (G T Demoz MSc); Department of Law Philosophy and Economic Studies, La Sapienza University, Rome, Italy (Prof C Abbafati PhD); Non-communicable Diseases Research Center (N Abbasi MD, F Farzadfar MD, S N Irvani MD, M Shams-Beyranvand MSc, H Ebrahimi MD, F Pishgar MD), Department of Health (H Abbastabar PhD), Department of Urology (E Amini MD), Department of Health Management and Economics (M Anjomshoa PhD, S Mousavi PhD), Liver and Pancreaticobiliary Disease Research Center (H Ebrahimi MD), Multiple Sclerosis Research Center (I Abdollahpour PhD, S Eskandarieh PhD, P Heydarpour MD, Prof M Sahraian MD), Endocrinology and Metabolism Research Center

(Prof A Esteghamati MD), School of Medicine (N Hafezi-Nejad MD), Department of Pharmacology (A Haj-Mirzaian MD), Department of Epidemiology and Biostatistics (Prof S Hosseini PhD), M Mansournia PhD, Prof M Yaseri PhD), Hematologic Malignancies Research Center (A Kasaieian PhD), Knowledge Utilization Research Center (Prof R Majdzadeh PhD), Digestive Diseases Research Institute (Prof R Malekzadeh MD, Prof A Pourshams MD, H Poustchi PhD, G Roshandel PhD, S G Sepanlou MD), Cancer Research Center (Prof A Nahvijou PhD), Uro-oncology Research Center (M Nowroozi MD, F Pishgar MD), Iranian National Center for Addiction Studies (INCAS) (Prof A Rahimi-Movaghar MD), Sina Trauma and Surgery Research Center (M Safdarian MD, Prof P Salamaty MD, M Sharif-Alhoseini PhD), Center of Expertise in Microbiology (Prof S Seyedmousavi PhD), Cancer Biology Research Center (Prof R Shirkoohi PhD), Department of Anatomy (S Sobhani MD), Hematology-Oncology and Stem Cell Transplantation Research Center (A Kasaieian PhD), Community-Based Participatory Research Center (Prof R Majdzadeh PhD), Cancer Research Institute (Prof R Shirkoohi PhD), Tehran University of Medical Sciences, Tehran, Iran; Montreal Neuroimaging Center (N Abbasi MD), Montreal Neurological Institute (S Fereshtehnejad PhD), McGill University, Montreal, QC, Canada; Department of Neurology (Prof F Abd-Allah MD, Prof A Abdelalim MD, Prof M I Hegazy PhD), Department of Medical Parasitology (M M Khater MD), Cairo University, Cairo, Egypt; Department of Epidemiology, Arak University of Medical Sciences, Arak, Iran (I Abdollahpour PhD); Department of Statistics, Manonmaniam Sundaranar University, Tirunelveli, India (R S Abdulkader MD); College of Health Sciences (H T Abebe PhD), School of Public Health (Prof S F Abera MSc, B M Adhena MPH, A B Belachew MSc), Clinical Pharmacy Unit (H N Abraha MSc, T D Kassa MSc, Y L Nirayo MSc, A K Gebre MSc, T G Gebremichael MSc, A G Tsadik MSc, E Yimer MSc), Department of Biostatistics (K Gezae MSc), Anatomy Unit (T B Hagos MSc), Biomedical Sciences Division (Prof G B Hailu MSc), School of Medicine (D T Mengistu MSc), Department of Microbiology and Immunology (S Muthupandian PhD), Department of Environmental Health Science (A A Werkneh MSc), Department of Midwifery (Prof Z M Zenebe MSc), Mekelle University, Mekelle, Ethiopia (E Belay MSc, Prof B D Demtsu MSc, S G Tassew MSc); Department of Clinical Chemistry (M Abebe MSc, B Biadgo BSc), Human Nutrition Department (Z Abebe MSc), Institute of Public Health (Prof K A Alene MPH, B Bekele MPH, Prof A F Dadi MPH, M A Limenih MSc, Prof M Melku MSc, Prof K Muchie MSc, G A Tessema MPH, B Tilahun PhD, Prof M M Wassie MSc), Department of Medical Microbiology (Z Tessema PhD), Department of Medical Parasitology (Prof A J Zeleke MSc), University of Gondar, Gondar, Ethiopia (H W Baynes MSc); Department of Nursing (A Alebel MSc, G A Dessie MSc, D H Kassa MSc, F W S Wagnew MSc), Department of Public Health (Y A Belay MPH, G D Kibret MPH, C T Leshargie MPH), College of Health Sciences (G M Kassa MSc), Debre Markos University, Debre Markos, Ethiopia (A N Abeje MPH); Institute of Biological Chemistry and Nutrition, University of Hohenheim, Stuttgart, Germany (Prof S F Abera MSc); Department of Medical Laboratory Sciences (O Abil MSc), Department of Health Sciences (Prof E Duken MSc), Wollega University, Nekemte, Ethiopia; School of Public Health, University of Medical Science, Ondo, Ondo, Nigeria (O Abil MSc); Department of Healthcare Policy and Research, Weill Cornell Medical College in Qatar, Doha, Qatar (Prof L J Abu-Raddad PhD); Epidemiology (M M K Accrombessi PhD), Bénin Clinical Research Institute (IRCB), Cotonou, Benin (E F A Avokpaho MD); Department of Preventive Medicine, Dongguk University, Gyeongju, South Korea (Prof D Acharya MPH); Department of Community Medicine, Kathmandu University, Devdaha, Nepal (Prof D Acharya MPH); Department of Global Health (A A Adamu MSc, O O Adetokunboh MSc, Prof C S Wiysonge MD), Faculty of Medicine & Health Sciences (Prof P S Nyasulu PhD), Department of Psychiatry (Prof C D H Parry PhD), Stellenbosch University, Cape Town, South Africa; Cochrane South Africa (A A Adamu MSc, O O Adetokunboh MSc), Burden of Disease Research Unit (R Matzopoulos PhD), Unit for Hypertension and Cardiovascular Disease (Prof A E Schutte PhD), South African Medical Research

Council, Cape Town, South Africa (Prof D J Stein MD); Medicine, University College Hospital, Ibadan, Ibadan, Nigeria (O M Adebayo MD); Department of Medical Rehabilitation, Obafemi Awolowo University, Ile-Ife, Nigeria (Prof R A Adedoyin PhD); School of Medicine, Cardiff University, Cardiff, UK (V Adekanmbi PhD); Emergency Department, Saint Mark Hospital, Alexandria, Egypt (M G Adib MD); School of Public Health, Wolaita Sodo University, Addis Ababa, Ethiopia (A Admasie MPH); Department of Family Medicine, McMaster University, Hamilton, ON, Canada (G Agarwal MD); Research Area for Informatics and Big Data, Csis Institute of Genomics and Integrative Biology, Delhi, India (Prof A Agrawal PhD); Department of Internal Medicine (Prof A Agrawal PhD), National School of Tropical Medicine (Prof P J Hotez PhD), Baylor College of Medicine, Houston, TX, USA; Health Promotion Division (M Arora PhD), Department of Social and Behavioral Sciences (S Goenka PhD), Non Communicable Diseases (Prof M R Mathur PhD), Indian Institute of Public Health (Prof S Zodpey PhD), Public Health Foundation of India, India (S Agrawal PhD, A Awasthi PhD, Prof L Dandona MD, Prof R Dandona PhD, G Kumar PhD, D K Lal MD, K Reddy DM); Vital Strategies, Gurugram, India (S Agrawal PhD); Department of Anesthesiology (Prof A Ahmadi PhD), Department of Traditional and Complementary Medicine (Prof M Farzaei PhD), Sleep Disorders Research Center (M Ghadami MD), Faculty of Nutrition and Food Sciences (F Heydarpour PhD), Faculty of Public Health (Prof B Karami Matin PhD, A Kazemi Karyani PhD), Department of Epidemiology & Biostatistics (Prof F Najafi PhD, Prof Y Salimi PhD), Environmental Determinants of Health Research Center (Prof S Rezaei PhD, M Soofi PhD), Department of Food Technology & Quality Control (Prof E Sadeghi PhD), Sports Medicine & Rehabilitation (M Shamsi PhD), Imam Ali Cardiovascular Research Center (Prof S Siabani PhD), Pharmaceutical Sciences Research Center (Prof M Farzaei PhD), Kermanshah University of Medical Sciences, Kermanshah, Iran (Prof S Heydarpour PhD, Prof M Pirsahab PhD, Prof S Rezaeian PhD, Prof K Sharafi PhD); Environmental Technologies Research Center (Prof M Ahmadi PhD), Department of Public Health (Prof M A Khafaei PhD), Thalassemia and Hemoglobinopathy Research Center (Prof F Rahim PhD), Department of Neurosurgery (Prof H Safari MD), Education Development Center (Prof M Sayyah PsyD), Medical Physics Department (Prof A Yadollahpour PhD), Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran; Health Systems and Population Studies Division (S Ahmed MSc), Initiative for Non Communicable Diseases (A Naheed PhD), Health Economics and Financing Research Group (A R Sarker MSc), Maternal and Child Health Division (S Zaman MPH), International Centre for Diarrhoeal Disease Research, Bangladesh, Dhaka, Bangladesh; Department of Learning, Informatics, Management, and Ethics (S Ahmed MSc), Department of Public Health Sciences (Prof P Allebeck MD, Z El-Khatib PhD), Department of Neurobiology (Prof J Årnlöv PhD), Department of Medical Epidemiology and Biostatistics (Prof J J Carrero PhD, Prof E Weidpass PhD), Department of Neurobiology, Care Sciences and Society (S Fereshtehnejad PhD), Karolinska Institutet, Stockholm, Sweden; University Ferhat Abbas of Setif, Algeria (A Aichour B Med Sc, I Aichour B Pharm); Higher National School of Veterinary Medicine, Algiers, Algeria (M Aichour MA); Cancer Research Center (Prof M Akbari MD), Research Institute for Endocrine Sciences (A Haj-Mirzaian MD, S N Irvani MD), Safety Promotion and Injury Prevention Research Center (Prof N Jahanmehr PhD), Department of Biostatistics (A Khajavi MSc), Department of Epidemiology (S Riahi PhD), Ophthalmic Research Center (S Safi MSc, Prof M Yaseri PhD), School of Public Health (Prof N Jahanmehr PhD), Ophthalmic Epidemiology Research Center (S Safi MSc), Shahid Beheshti University of Medical Sciences, Tehran, Iran; Institute for Advanced Medical Research and Training, University of Ibadan, Ibadan, Nigeria (R O Akinyemi PhD, Prof M O Owolabi DrM); Centre for Global Child Health, The Hospital for Sick Children (N Akseer PhD), Department of Nutritional Sciences (A Badawi PhD), The Centre for Global Child Health, Hospital for Sick Children (Prof Z A Bhutta PhD), University of Toronto, Toronto, ON, Canada; Internal Medicine Department, Washington University in St Louis, St Louis, MO, USA (Z Al-Aly MD); Clinical Epidemiology Center, VA St Louis Health Care System, Department of Veterans Affairs, St Louis, MO, USA (Z Al-Aly MD); Pediatric Intensive Care Unit (A Al-Eyadhy MD), Department of Pediatrics (Prof B H Sobaih MD, Prof M Temsah MRCPC, MD), King Saud University, Riyadh, Saudi Arabia (K Altirkawi MD); Department of Family and Community Medicine, King Abdulaziz University, Jeddah, Saudi Arabia (Prof R M Al-Raddadi PhD); Evidence Based Practice Center, Mayo Clinic Foundation for Medical Education and Research, Rochester, MN, USA (Prof F Alahdab MD); Research Committee, Syrian American Medical Society, Washington, DC, USA (Prof F Alahdab MD); School of Population and Global Health (K Alam PhD), School of Medicine (Prof G J Hankey MD), University of Western Australia, Perth, WA, Australia; Research School of Population Health (Prof K A Alene MPH), National Centre for Epidemiology and Population Health (M Bin Sayeed MSPS, A Parisi MD), Australian National University, Canberra, ACT, Australia; Department of Public Health (Prof A H Pakpour PhD), Qazvin University of Medical Sciences, Qazvin, Iran (M Alijanzadeh PhD); Gastrointestinal Cancer Research Center (R Alizadeh-Navaei PhD), Department of Medical Mycology (Prof H Badali PhD), Toxoplasmosis Research Center (Prof A Daryani PhD, Prof S Sarvi PhD), Department of Physiology and Pharmacology (Prof M Mohammadi PhD), Molecular and Cell Biology Research Center (Prof A Rafiei PhD), Department of Pediatrics (Prof M Rezaei MD), Department of Medical Mycology and Parasitology (A Vaezi PhD), Department of Immunology (Prof A Rafiei PhD), Mazandaran University of Medical Sciences, Sari, Iran (Prof M Fakhhar PhD, Prof A Hedayatizadeh-Omran PhD, M Nourollahpour Shiadeh PhD, Prof Z Zare PhD); Department of Health Policy and Management, Kuwait University, Safat, Kuwait (Prof S M Aljumid PhD); International Centre for Casemix and Clinical Coding, National University of Malaysia, Bandar Tun Razak, Malaysia (Prof S M Aljumid PhD); Department of Population Health, Luxembourg Institute of Health, Strassen, Luxembourg (A Alkerwi PhD); Isped, University of Bordeaux, Bordeaux, France (Prof F Alla PhD); Swedish Research Council for Health, Working Life, and Welfare, Stockholm, Sweden (Prof P Allebeck MD); Research Program in Epidemiology & Public Health, Hospital Del Mar Medical Research Institute, Barcelona, Spain (Prof J Alonso MD); Department of Experimental and Health Sciences, Pompeu Fabra University, Barcelona, Spain (Prof J Alonso MD); Research Group on Health Economics (Prof N Alvis-Guzman PhD), Epiunit, Instituto de Saúde Pública (Prof C Castro PhD), University of Cartagena, Cartagena, Colombia; Research Group in Hospital Management and Health Policies, University of the Coast, Barranquilla, Colombia (Prof N Alvis-Guzman PhD); Sansom Institute (A Amare PhD), Wardliparingga Aboriginal Research Unit (P S Azzopardi PhD), South Australian Health and Medical Research Institute, Adelaide, SA, Australia; Department of Public Health Nutrition (N Fentahun PhD), Bahir Dar University, Bahir Dar, Ethiopia (A Amare PhD); School of Public Health (L N Aminde MD, F J Charlson PhD, H E Erskine PhD, A J Ferrari PhD, D F Santomauro PhD, Prof J G Scott PhD), School of Dentistry (Prof R Laloo PhD), Institute for Social Science Research (J C Maravilla PhD), Queensland Brain Institute (Prof J J McGrath MD), The University of Queensland, Brisbane, QLD, Australia (Prof H A Whiteford PhD); Department of the Health Industrial Complex and Innovation in Health (Prof D A Silveira MSc), Federal Ministry of Health, Beirut, Lebanon (Prof W Ammar PhD); Faculty of Health Sciences, American University of Beirut, Beirut, Lebanon (Prof W Ammar PhD); Department of Internal Medicine, Komfo Anokye Teaching Hospital, Kumasi, Ghana (Y A Amoako MD); Faculty of Medicine (N H Anber PhD), Department of Clinical Pathology (Prof M El Sayed Zaki PhD), Mansoura University, Mansoura, Egypt (N H Anber PhD); Emergency Hospital of Bucharest (Prof M Beuran PhD, Prof I Negoii PhD), Department of General Surgery (Prof D V Davitoiu PhD, Prof M Hostiu PhD), Department of Legal Medicine and Bioethics (Prof S Hostiu PhD), Anatomy and Embryology Department (Prof R I Negoii PhD), Carol Davila University of Medicine and Pharmacy, Bucharest, Romania (C Andrei PhD); Department of Medicine, University of Thessaly, Volos, Greece (Prof S Androudi PhD); Department of Public Health (Y C D Geramo MSc, M Y Teshale MPH), Medical Laboratory Science (Prof M Hussen MA), Arba Minch University, Arba Minch, Ethiopia

(M D Animut MPH); Social Determinants of Health Research Center (M Anjomshoa PhD), Rafsanjan University of Medical Sciences, Rafsanjan, Iran; Zahedan University of Medical Sciences, Iran (Prof H Ansari PhD); Department of Public Health (M G Ansha MPH, Prof T Kolola MPH), Department of Midwifery (M T Dinberu MA), Debre Berhan University, Debre Berhan, Ethiopia; Department of Health Policy and Administration (C T Antonio MD), Development and Communication Studies (E K Macarayan PhD), University of the Philippines Manila, Manila, Philippines; Research Unit (R Ofori-Asenso MSc), Independent Consultant, Kabul, Afghanistan (P Anwari MSc); School of Health Sciences, Birmingham City University, Birmingham, England (O Aremu PhD); School of Health and Social Studies, Dalarna University, Falun, Sweden (Prof J Årnlöv PhD); School of Science and Health (A Arora PhD), School of Social Sciences and Psychology (Prof A M N Renzaho PhD), Western Sydney University, Sydney, NSW, Australia (F A Ogbo PhD); Oral Health Services, Sydney Local Health District, Sydney, NSW, Australia (A Arora PhD); Health Related Information Dissemination Amongst Youth, New Delhi, India (M Arora PhD); Department of Community Health Sciences, University of Manitoba, Winnipeg, MB, Canada (A Artaman PhD); DFID Nepal Health Sector Programme 3, Monitoring Evaluation and Operational Research Project, Abt Associates Nepal, Lalitpur, Nepal (K K Aryal PhD); Qom University of Medical Sciences, Qom, Iran (H Asayesh MSc); University Institute of Public Health, The University of Lahore, Lahore, Pakistan (S Atique PhD); Public Health Department (S Atique PhD), Department of Family and Community Medicine (Prof I A Ginawi MD), University of Hail, Hail, Saudi Arabia; Center for Clinical Global Health Education (S R Atre PhD), Department of Radiology (N Hafezi-Nejad MD, A Haj-Mirzaian MD), Department of Epidemiology (S Hutfless PhD, Prof J B Nacheqa PhD), Department of Health Policy and Management (Prof A T Khoja MD), School of Medicine (S Hutfless PhD), Johns Hopkins University, Baltimore, MD, USA; Dr D Y Patil Medical College (S R Atre PhD), Dr D Y Patil Vidyapeeth, Pune, India (A R Sawant MD); School of Business (Prof M Ausloos PhD), Department of Health Sciences (Prof T Brugha MD), University of Leicester, Leicester, UK; Control of Infectious Diseases, Laboratory of Studies and Research-Action in Health, Porto Novo, Benin (E F A Avokpaho MD); Indian Institute of Public Health, Gandhinagar, India (A Awasthi PhD); The Judith Lumley Centre (B Ayala Quintanilla PhD), School of Nursing and Midwifery (Prof D Edvardsson PhD), Austin Clinical School of Nursing (M Rahman PhD), La Trobe University, Melbourne, VIC, Australia; General Office for Research and Technological Transfer, Peruvian National Institute of Health, Lima, Peru (B Ayala Quintanilla PhD); Department of Community and Global Health (R Ayer MSc), Department of Global Health Policy (Prof S Nomura MSc), University of Tokyo, Tokyo, Japan; Global Adolescent Health Group, Burnet Institute, Melbourne, VIC, Australia (P S Azopardi PhD); Department of Infectious Diseases, Center for Infectious Diseases Research, Babol, Iran (A Babazadeh MD, Prof S Ebrahimipour PhD); School of Health Sciences (U Bacha M Phil), School of Food and Agricultural Sciences (N Khalid PhD), University of Management and Technology, Lahore, Pakistan; Public Health Risk Sciences Division (A Badawi PhD), Applied Research Division (H M Orpana PhD), Public Health Agency of Canada, Toronto, ON, Canada; Department of Hypertension, Medical University of Lodz, Lodz, Poland (Prof M Banach PhD); Polish Mothers' Memorial Hospital Research Institute, Lodz, Poland (Prof M Banach PhD); Department of Mathematical Demography & Statistics (K Banerjee MSc), Department of Public Health & Mortality Studies (M H U Rahman M Phil, Prof U Ram PhD), International Institute for Population Sciences, Mumbai, India (S Goli PhD, P Kumar PhD, M H U Rahman M Phil); Faculty of Medicine, Alexandria University, Alexandria, Egypt (J A M Banoub MD); Department of Transplant Services, University Hospital Foundation Santa Fe de Bogotá, Bogotá, Colombia (J A M Banoub MD); Department of Neurosciences, Rafael A Calderón Guardia Hospital (Prof M A Barboza MSc), Area de Estadística, Dirección Actuarial (Prof J Castillo Rivas MSc), Costa Rican Department of Social Security, San Jose, Costa Rica; School of Medicine (Prof M A Barboza MSc), School of Dentistry (Prof J Castillo Rivas MSc), University of Costa Rica, San Pedro, Costa Rica; School of Psychology (Prof S L Barker-Collo PhD), Molecular Medicine and Pathology (K B Tran MD), University of Auckland, Auckland, New Zealand; Institute of Public Health (Prof T W Bärnighausen MD, Prof J De Neve MD, B Moazen MSc, S Mohammed PhD), Department of Ophthalmology (Prof J B Jonas MD), Medical Clinic V (Prof W März MD), Augenpraxis Jonas (S Panda-Jonas MD), Heidelberg University, Heidelberg, Germany; Department of Global Health and Population (Prof T W Bärnighausen MD, A B Feigl PhD, Prof O F Norheim PhD), Department of Nutrition (E L Ding DSc, M S Farvid PhD), T H Chan School of Public Health (P C Gupta DSc), Ariadne Labs (E K Macarayan PhD), Department of Genetics (A Pereira PhD), Division of General Internal Medicine and Primary Care (Prof A Sheikh MSc), Heart and Vascular Center (M Vaduganathan MD), Department of Environmental Health (G R Wagner MD), Harvard University, Boston, MA, USA (N Islam PhD, M G Shrimme MD, B Yakob PhD); Center for Nutrition and Health Research (E Denova-Gutiérrez DSc), Center for Health Systems Research (H Gómez-Dantés MSc, M Rios-Blancas MPH, Prof E Serván-Mori DSc), Center for Population Health Research (C Razo-García MSc), National Institute of Public Health, Cuernavaca, Mexico (S Barquera PhD, I R Campos-Nonato PhD, J Campuzano Rincon PhD, Prof R Lozano PhD); Department of Industrial Engineering, Pontifical Javeriana University, Bogota, Colombia (Prof L H Barrero DSc); Barcelona Institute for Global Health (Prof Q Bassat MD), Tuberculosis Department (A L Garcia-Basteiro MSc), Barcelona Institute for Global Health, Barcelona, Spain (Prof J V Lazarus PhD); Tuberculosis (A L Garcia-Basteiro MSc), Manhiça Health Research Center, Manhiça, Mozambique (Prof Q Bassat MD); Department of Medicine, Stanford University, Palo Alto, CA, USA (Prof S Basu PhD); Melbourne Medical School, Melbourne, VIC, Australia (Prof B T Baune PhD); Department of Psychiatry, Charles R Drew University of Medicine and Science, Los Angeles, CA, USA (Prof S Bazargan-Hejazi BEP); Department of Psychiatry and Biobehavioral Sciences, University of California Los Angeles, Los Angeles, CA, USA (Prof S Bazargan-Hejazi BEP); Department of Community Medicine, Gandhi Medical College Bhopal, Bhopal, India (Prof N Bedi MD); Jazan University, Jazan, Saudi Arabia (Prof N Bedi MD); Department of Neuroscience (E Beghi MD, G Giussani PhD), Department of Renal Medicine (B Bikbov MD, N Perico MD), Department of Oncology (C Bosetti PhD, M Cortinovich PhD), Department of Environmental Health Science (S Gallus DSc), Mario Negri Institute for Pharmacological Research, Milan, Italy (Prof G Remuzzi MD); Health Management and Economics Research Center (M Behzadifar PhD), Department of Ophthalmology (K Ghasemi Falavarjani MD), Air Pollution Research Center (B Heibati PhD), Preventive Medicine and Public Health Research Center (M Moradi-Lakeh MD, Prof A Tehrani-Banihashemi PhD), Department of Neuroscience (M Safdarian MD), Department of Health Policy (H Shabaninejad PhD), Department of Community Medicine (Prof A Tehrani-Banihashemi PhD), Physiology Research Center (M Yousefifard PhD), Iran University of Medical Sciences, Tehran, Iran (T Beyranvand PhD, F Farhadi MD); Social Determinants of Health Research Center (M Behzadifar PhD), Lorestan University of Medical Sciences, Khorramabad, Iran (M Behzadifar MS); Department of Neurology, University Hospital of Dijon, Dijon, France (Prof Y Béjot PhD); Dijon Stroke Registry - Ufr Sciences Santé, University of Burgundy, Dijon, France (Prof Y Béjot PhD); Public Health Department (B Bekele MPH, H Y Hassen MPH), Pharmacy Department (A T Kefale MSc), Mizan-tepi University, Teppi, Ethiopia (Prof A Henok MPH); School of Forestry and Environmental Studies (Prof M L Bell PhD), Department of Ophthalmology and Visual Science (Prof J J Huang MD), Yale University, New Haven, CT, USA; Department of Medicine, University of Alberta, Edmonton, AB, Canada (Prof A K Bello PhD); Nuffield Department of Population Health (D A Bennett PhD), Nuffield Department of Medicine (Prof P W Gething PhD), Department of Psychiatry (Prof C R J Newton MD), Nuffield Department of Women's and Reproductive Health (Prof K Rahimi MD), University of Oxford, Oxford, UK (Prof V Jha MD); Department of Internal Medicine (I M Bensenor PhD, Prof I S Santos PhD), Ribeirão Preto Medical School, Division of Ophthalmology (Prof J M Furtado MD), University Hospital, Internal Medicine Department (A C Goulart PhD),

Department of Medicine (Prof P A Lotufo DrPH), Department of Biomechanics (L G Mandarano-Filho PhD), Laboratory of Genetics and Molecular Cardiology (A Pereira PhD), Department of Pathology and Legal Medicine (M R Tovani-Palone MSc), Department of Psychiatry (Y Wang PhD), Center for Clinical and Epidemiological Research (A C Goulart PhD), University of São Paulo, São Paulo, Brazil; Division of Cardiology, Medical College of Georgia at Augusta University, Augusta, GA, USA (Prof A E Berman MD); Department of Health Policy (Prof A E Berman MD), Personal Social Services Research Unit (R Kadel MPH), London School of Economics and Political Science, London, UK; Dental Institute (E Bernabe PhD), Faculty of Life Sciences and Medicine (Prof P I Dargan MB, M Molokhia PhD), St John's Institute of Dermatology (Prof R J Hay MD), Division of Patient and Population (Prof W Marcenes PhD), School of Population Health & Environmental Sciences (Prof C D A Wolfe MD), King's College London, London, UK; Hubert Department of Global Health (R S Bernstein MD), Rollins School of Public Health (Prof Y Liu PhD), Emory University, Atlanta, GA, USA; Department of Global Health, University of South Florida, Tampa, FL, USA (R S Bernstein MD); Department of Internal Medicine (Prof A Bhalla MD, D P Lad DM), Department of Pediatrics (S D Lad MD), Post Graduate Institute of Medical Education and Research, Chandigarh, India; Department of Infectious Disease Epidemiology (O J Brady PhD, Prof H J Larson PhD), Department of Disease Control (Prof J Cano PhD), Department of Health Services Research and Policy (Prof M McKee DSc), London School of Hygiene & Tropical Medicine, London, UK (S Bhattarai MSc); Nepal Academy of Science & Technology, Patan, Nepal (S Bhattarai MSc); George Institute (Prof V Jha MD), Research (Prof P K Maulik PhD), The George Institute for Global Health, New Delhi, India (S Bhaumik MBBS); Center of Excellence in Women and Child Health, Aga Khan University, Karachi, Pakistan (Prof Z A Bhutta PhD); Social Determinant of Health Research Center (A Bijani PhD), Health Research Institute (Prof R Ghadimi PhD, M Ghasemi-Kasman PhD), Fatemeh Zahra Infertility and Reproductive Health Center (Prof P Mirabi PhD), Department of Clinical Biochemistry (N Neamati MSc, Prof H Parsian PhD), Cellular and Molecular Biology Research Center (H Nouri PhD), Infectious Diseases and Tropical Medicine Research Center (A Rostami PhD), Immunoregulation Research Center (Prof S Seyedmousavi PhD), Department of Microbiology and Immunology (Prof M Shahbazi PhD), Student Research Committee (M Zamani MD), Babol University of Medical Sciences, Babol, Iran (Prof M Faramarzi PhD, S Mouodi MD); Department of Epidemiology and Biostatistics (V Bilano PhD, F B Piel PhD), Department of Primary Care and Public Health (M Car PhD, Prof A Majeed MD, Prof S Rawaf PhD), Department of Surgery and Cancer (Prof A C Davis PhD), Department of Infectious Disease Epidemiology (Prof C A Donnelly DSc), WHO Collaborating Centre for Public Health Education and Training (D L Rawaf MD), School of Public Health (Prof S Saxena MD), Imperial College London, London, UK; Woldia University, Woldia, Ethiopia (N Bililign B Hlth Sci); Department of Clinical Pharmacy and Pharmacology, University of Dhaka, Ramna, Bangladesh (M Bin Sayeed MSPS); Global Health Division, Research Triangle Institute International, Research Triangle Park, NC, USA (D Bisanzio PhD); School of Medicine, University of Nottingham, Nottingham, UK (D Bisanzio PhD, F Shokraneh MSc); Department of Health Sciences (I Filip MD), A T Still University, Brisbane, QLD, Australia (T Biswas MPH, A Radfar MD); General Directorate of Health Information Systems (B Bora Basara PhD), Department of Public Health (A Chittheri FETP), Epidemiology & Disease Control (Prof S Ma PhD), Research Department, Prince Mohammed Bin Abdulaziz Hospital (Prof Z A Memish MD), NCD Prevention & Control Unit (S S Ong MBBS, FAMS), Health and Disability Intelligence Group (I Salz MD), Department of Health Statistics (G K Yentür MSc), Ministry of Health, Ankara, Turkey (M Car PhD, B Er MSc); Centre for Adolescent Health (R Borschmann PhD), Population Health Group (Prof G C Patton MD), Murdoch Children's Research Institute, Melbourne, VIC, Australia (Prof R G Weintraub MB); School of Population and Global Health (R Borschmann PhD), Department of Medicine (Prof B C Cowie PhD), Department of Paediatrics (Prof M T Mackay PhD, Prof G C Patton MD), School of Health Sciences (Prof A Meretoja MD, Prof C E I Szoek PhD), University of Melbourne, Carlton, Melbourne, VIC, Australia

(Prof A D Lopez PhD); Department of General Practice and Health Services Research, Heidelberg University Hospital, Germany (K Bozorgmehr MSc); School of Medicine and Clinical Hospital (Prof L C Brant PhD), Department of Maternal and Child Nursing and Public Health (Prof D C Malta PhD), Hospital of the Federal University of Minas Gerais (Prof B R Nascimento PhD, Prof A P Ribeiro MD), Post-graduate Program in Infectious Diseases and Tropical Medicine (B P Sao Jose PhD), Federal University of Minas Gerais, Belo Horizonte, Brazil; Department of Public Health and Primary Care (Prof C Brayne MD, Prof R Chowdhury PhD), MRC Epidemiology Unit (N Islam PhD), University of Cambridge, Cambridge, UK; Institute of Epidemiology, Comenius University, Bratislava, Slovakia (Prof A Brazinova MD); Department of Psychology (Prof N J K Breitborde PhD), College of Public Health (Prof M Yotebieng PhD), Psychiatry and Behavioral Health Department (Prof N J K Breitborde PhD), The Ohio State University, Columbus, OH, USA; Division of Clinical Epidemiology and Aging Research, German Cancer Research Center, Heidelberg, Germany (Prof H Brenner MD, B Schöttker PhD); Department of Neuroscience, Institute for Scientific Research and High Technology Services, City Of Knowledge, Panama (G Britton PhD); Department of Research and Health Technology Assessment (F Castro MD) Gorgas Memorial Institute for Health Studies, Panama, Panama (G Britton PhD, I Moreno Velásquez PhD, H Quintana PhD); Institute of Public Health (Prof R Busse PhD, Prof E Schaeffner MD), Department of Neurology (Prof M Endres MD), Department of Operative and Preventive Dentistry (Prof F Schwendicke MPH), Charité University Medical Center Berlin, Berlin, Germany; School of Population and Public Health (Z A Butt PhD, Prof N Sarrafzadegan MD), University of British Columbia, Vancouver, BC, Canada (J A Kopec PhD); Al Shifa School of Public Health, Al Shifa Trust Eye Hospital, Rawalpindi, Pakistan (Z A Butt PhD); School of Medicine, University of the Valley of Cuernavaca, Cuernavaca, Mexico (J Campuzano Rincon PhD); Department of Population and Health, Metropolitan Autonomous University, Mexico City, Mexico (Prof R Cárdenas DSc); Institute for Cancer Research, Prevention and Clinical Network, Florence, Italy (G Carreras PhD); Institute of Public Health (Prof F Carvalho PhD), Institute of Biomedical Engineering (J Das Neves PhD), REQUIMTE/LAUV (Prof E Fernandes PhD, Prof D M Pereira PhD), Department of Community Medicine, Information and Health Decision Sciences, Cintesis, Faculty of Medicine (J V Santos MD), UciBio (J P Silva PhD), Applied Molecular Biosciences Unit (Prof F Carvalho PhD), Institute for Research and Innovation in Health (I3S) (J Das Neves PhD), University of Porto, Porto, Portugal; Colombian National Health Observatory, National Institute of Health, Bogota, Colombia (C A Castañeda-Orjuela MSc); Epidemiology and Public Health Evaluation Group (C A Castañeda-Orjuela MSc), Department of Public Health (Prof F P De La Hoz PhD), National University of Colombia, Bogota, Colombia; Department of Epidemiology, Portuguese Oncology Institute of Porto, Porto, Portugal (Prof C Castro PhD); Department of Health Planning and Economics, Institute of Health Carlos III, Madrid, Spain (F Catalá-López PhD); Mary Mackillop Institute for Health Research (Prof E Cerin PhD), Institute for Positive Psychology and Education (Prof C Lonsdale PhD), The Brain Institute (Prof C E I Szoek PhD), Australian Catholic University, Melbourne, VIC, Australia; School of Public Health (Prof E Cerin PhD), Centre for Suicide Research and Prevention (Prof P Yip PhD), University of Hong Kong, Hong Kong, China (Prof P Yip PhD); College of Medicine, Alfaisal University, Riyadh, Saudi Arabia (Y Chaiah, Prof Z A Memish MD, Prof M Tamsah MRCPC, MD, O Tamsah); College of Medicine (Prof J Chang PhD), Institute of Epidemiology and Preventive Medicine (Y Wu MSc), National Taiwan University, Taipei, Taiwan; Surgical Oncology, Tata Memorial Hospital, Mumbai, India (Prof P Chaturvedi MD); Clinical Governance, Gold Coast Health, Gold Coast, QLD, Australia (P P Chiang PhD); Institute of Industrial Ecological Science, University of Occupational and Environmental Health, Kitakyushu, Japan (O Chimed-Ochir PhD); Department of Population Studies, University of Zambia, Lusaka, Zambia (V H Chisumpa PhD, C Mapoma PhD); Demography and Population Studies, University of the Witwatersrand, Johannesburg, South Africa (V H Chisumpa PhD); Institute of Clinical Medicine and Bispebjerg

Hospital (Prof H Christensen DMSci), Department of Neurology (T C Truelsen PhD), University of Copenhagen, Copenhagen, Denmark; Department of Pulmonary Medicine (Prof D J Christopher MD), Department of Neurology (Prof J D Pandian MD), Department of Endocrinology (Prof N Thomas PhD), Christian Medical College and Hospital (CMC), Vellore, India; Department of Health Informatics (S Chung PhD), Ear Institute (Prof A C Davis PhD), Department of Epidemiology and Public Health (Prof M Kivimäki PhD), Prof M R Mathur PhD, Department of Psychology (M Kumar PhD), University College London, London, UK; Health Data Research UK, London, UK (S Chung PhD); School of Public Health and Preventive Medicine (Prof F M Cicuttini PhD, Prof Y Guo PhD, S Li PhD, S Si PhD), Centre of Cardiovascular Research and Education in Therapeutics (R Ofori-Asenso MSc), Monash University, Melbourne, VIC, Australia (Prof A G Thrift PhD); Adelaide Medical School (L G Ciobanu PhD, T K Gill PhD), School of Public Health (G A Tessema MPH), University of Adelaide, Adelaide, SA, Australia (A T Olagunju MD); Scuola Medica Salernitana, University of Salerno, Baronissi, Italy (Prof M Cirillo MD); Health Effects Institute, Boston, MA, USA (A J Cohen DSc); Department of Cardiovascular Medicine, Mayo Clinic, Jacksonville, FL, USA (L T Cooper MD); Malaria Vaccines (C Karema MPH), Epidemiology and Public Health (T Fürst PhD), Swiss Tropical and Public Health Institute, Basel, Switzerland; Quality and Equity Health Care, Kigali, Rwanda (C Corine MPH); School of Medicine and Surgery, University of Milan Bicocca, Monza, Italy (P A Cortesi PhD, C Fornari PhD, A Lafranconi MD, F Madotto PhD); Postgraduate Program in Epidemiology, Federal University of Rio Grande do Sul, Porto Alegre, Brazil (E Cousin MSc, B B Duncan MD, Prof M I Schmidt PhD); WHO Collaborating Centre for Viral Hepatitis (Prof B C Cowie PhD), Victorian Infectious Diseases Service (VIDS) (K B Gibney PhD), Epidemiology Discipline (J H MacLachlan MSc), The Peter Doherty Institute for Infection and Immunity, Melbourne, VIC, Australia; Department of Family Medicine and Public Health, University of California San Diego, La Jolla, CA, USA (Prof M H Criqui MD); Centre for International Health, University of Otago, Dunedin, New Zealand (Prof J A Crump MD); Division of Infectious Diseases and International Health (Prof J A Crump MD), Duke University School of Medicine (P P Doshi MS), Duke Global Health Institute (Prof L L Yan PhD), Duke University, Durham, NC, USA; College of Medicine and Health Sciences (A K Daba MSc), Department of Reproductive Health (D T Hibstu MPH), Hawassa University, Hawassa, Ethiopia; Discipline of Public Health, Flinders University, Adelaide, SA, Australia (Prof A F Dadi MPH); Institute for Global Health Innovations, Duy Tan University, Hanoi, Vietnam (A K Dang MD, L H Nguyen MPH, T H Nguyen BMedSc, N T Truong B Hlth Sci); Clinical Toxicology Service (Prof P I Dargan MB), Biomedical Research Council (Prof C D A Wolfe MD), Guy's and St Thomas' NHS Foundation Trust, London, UK; Department of Rheumatology, K G Medical University, Lucknow, India (Prof S K S Das MD); James P Grant School of Public Health (R Das Gupta MPH, M Hasan MPH, I Sutradhar MPH), Research and Evaluation Division (M Rahman PhD), BRAC University, Dhaka, Bangladesh; Central University of Tamil Nadu, Thiruvavur, India (Prof A P Dash DSc); Department of Surgery, Clinical Emergency Hospital St. Pantelimon, Bucharest, Romania (Prof D V Davitoiu PhD); Kazakh National Medical University, Almaty, Kazakhstan (Prof K Davletov PhD); National Drug and Alcohol Research Centre (Prof L Degenhardt PhD), South Western Sydney Clinical School (Prof G B Marks PhD), School of Medicine (Prof P K Maulik PhD, Prof B Neal PhD), School of Psychiatry (Prof P S Sachdev MD), University of New South Wales, Sydney, NSW, Australia; Population Dynamics and Reproductive Health Unit, African Population Health Research Centre, Nairobi, Kenya (T T Degfie PhD); Department of Clinical Pharmacy, Aksum University, Aksum, Ethiopia (G T Demoz MSc); Department of Global Health and Infection, Brighton and Sussex Medical School, Brighton, UK (K Deribe PhD); National Health Service Scotland, Edinburgh, UK (N Dervenis MD, G M A Wyper MSc); Aristotle University of Thessaloniki, Thessaloniki, Greece (N Dervenis MD); Department of Psychiatry (Prof D C Des Jarlais PhD), Department of Medicine (Prof J R Masci MD), Icahn School of Medicine at Mount Sinai, New York, NY, USA; Disha Foundation, Gurgaon, India (S Dey PhD); Department of Community Medicine, University of Peradeniya, Peradeniya, Sri Lanka (S D Dharmaratne MD); Swedish Family Medicine - First Hill, Seattle, WA, USA (M A Dirac MD); Deputy of Research and Technology (Prof S Djalalinia PhD), Center of Communicable Disease Control (B Eshrati PhD), Department of Human Resources (Z Kazemi MSc), Ministry of Health and Medical Education, Tehran, Iran (Z Kazemi MSc, Prof A Khosravi PhD); Department of Social Medicine and Health Care Organisation, Medical University of Varna, Varna, Bulgaria (Prof K Dokova PhD); Department of Population and Health, University of Cape Coast, Cape Coast, Ghana (D T Doku PhD); Faculty of Social Sciences, Health Sciences (D T Doku PhD), Faculty of Health Sciences, Health Sciences (S Neupane PhD), University of Tampere, Tampere, Finland; University of Rochester, Rochester, NY, USA (E Dorsey MD); School of Health and Biomedical Sciences (Prof K E Doyle PhD, Prof A L Zhang PhD), Department of Psychology (Prof S R Robinson PhD), Royal Melbourne Institute of Technology University, Bundoora, VIC, Australia; Sydney School of Public Health (Prof T R Driscoll PhD), Sydney Medical School (S Islam PhD), Asbestos Diseases Research Institute (J Leigh MD), Woolcock Institute of Medical Research (Prof G B Marks PhD), University of Sydney, Sydney, NSW, Australia (D G Hoy PhD, M A Mohammed PhD, Prof K Takahashi PhD); United Nations World Food Programme, New Delhi, India (M Dubey PhD); Faculty of Medicine (E Dubljanin PhD), Institute of Social Medicine, Centre School of Public Health and Health Management (Prof M M Santric Milicevic PhD), University of Belgrade, Belgrade, Serbia; School of Medicine, Federal University of Bahia, Salvador, Brazil (Prof A R Duraes PhD); Diretoria Médica, Roberto Santos General Hospital, Salvador, Brazil (Prof A R Duraes PhD); Department of Nursing, Umeå University, Umeå, Sweden (Prof D Edvardsson PhD); Department of Community Medicine, University of Tromsø, Tromsø, Norway (Prof A E Eggen PhD); Department of Community Medicine, Tripoli University, Tripoli, Libya (H Elkout PhD); Health Information (H Elkout PhD), Tuberculosis Health Topic (K W Rade MD), World Health Organization (WHO), Tripoli, Libya; Department of Pathology, Stavanger University Hospital, Stavanger, Norway (C L Ellingsen MD); Centre for Disease Burden (A S Knudsen PhD), Division of Mental and Physical Health (Prof S Øverland PhD), Norwegian Institute of Public Health, Oslo, Norway (C L Ellingsen MD); Public Health Department, Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia (A Y Endries MPH); Policy and Epidemiology Group (D F Santomauro PhD), Child and Youth Mental Health (Prof J G Scott PhD), Queensland Centre for Mental Health Research, Brisbane, QLD, Australia (H E Erskine PhD, A J Ferrari PhD); Department of Public Health (Prof R Esmaeili PhD), Gonabad University of Medical Sciences, Gonabad, Iran; Department of Medical Parasitology and Mycology, Urmia University of Medical Science, Urmia, Iran (Prof H Fakhim PhD); College of Medicine (M Fareed PhD), Department of Public Health (Prof A T Khoja MD), Imam Muhammad Ibn Saud Islamic University, Riyadh, Saudi Arabia; National Statistical Office, Lisbon, Portugal (C S E Farinha MSc); Department of Psychology, Federal University of Sergipe, Sao Cristovao, Brazil (Prof A Faro PhD); National Institute for Stroke and Applied Neurosciences, Auckland University of Technology, Auckland, New Zealand (Prof V L Feigin PhD); Health Division, Organisation for Economic Co-operation and Development, Paris, France (A B Feigl PhD); Center for Biotechnology and Fine Chemistry - Associate Laboratory, Faculty of Biotechnology, Catholic University of Portugal, Porto, Portugal (J C Fernandes PhD); Department of Psychiatry (I Filip MD), Division of Research (J O Lam PhD), Kaiser Permanente, Fontana, CA, USA; Department of Public Health Medicine, Bielefeld University, Bielefeld, Germany (F Fischer PhD); Institute of Gerontology, National Academy of Medical Sciences of Ukraine, Kyiv, Ukraine (N A Foigt PhD); Gene Expression & Regulation Program, Cancer Institute, Philadelphia, PA, USA (T Fukumoto PhD); Department of Dermatology, Kobe University, Kobe, Japan (T Fukumoto PhD); University of Basel, Basel, Switzerland (T Fürst PhD); Faculty of Business and Management (M A Garcia-Gordillo PhD), Institute of Physical Activity and Health (Prof P R Olivares PhD), Autonomous University of Chile, Talca, Chile; School of Public Health, Curtin University, Perth, WA, Australia

(A T Gebremedhin MPH, D Hendrie PhD, T R Miller PhD); Division of Human Nutrition and Health, Wageningen University & Research, Wageningen, Netherlands (Prof J M Geleijnse PhD); Directorate General for Public Health, Regional Health Council, Madrid, Spain (R Genova-Maleras MSc); Department of Health Care Policy and Management, University of Tsukuba, Tsukuba, Japan (M Ghimire MA); The Royal Melbourne Hospital, Melbourne, VIC, Australia (K B Gibney PhD); Unit of Academic Primary Care (Prof P S Gill DM), Division of Health Sciences (Prof O A Uthman PhD), University of Warwick, Coventry, UK; Department of Community and Family Medicine (R R F Gillum MD), Division of General Internal Medicine (R R F Gillum MD), Howard University, Washington, DC, USA; Department of Neurology (Prof M Giroud PhD), Department of Vital and Health Statistics (H L Harb MPH), Department of Disease, Epidemics, and Pandemics Control (J Nansseu MD), Ministry of Public Health, Dijon, France; Faculty of Medicine, Postgraduate Medical Institute, Dijon, France (Prof M Giroud PhD); Physical Activity and Obesity Prevention (S Goenka PhD), Centre for Chronic Disease Control, New Delhi, India (Prof S Liu PhD); Center for the Study of Regional Development, Jawahar Lal Nehru University, New Delhi, India (S Goli PhD); Nursing and Health Sciences Department, University of Massachusetts Boston, Boston, MA, USA (Prof P N Gona PhD); Department of Biostatistics and Epidemiology, University of Oklahoma, Oklahoma City, OK, USA (S V Gopalani MPH); Department of Health and Social Affairs, Government of the Federated States of Micronesia, Palikir, Federated States of Micronesia (S V Gopalani MPH); Metabolic Epidemiology Section, National Cancer Center, Chuo-ku, Japan (A Goto MD); School of Medicine, Boston University, Boston, MA, USA (A Grada MD); Registro Tumori Integrato, Vittorio Emanuele University Hospital Polyclinic, Catania, Italy (G Grosso PhD); Department of Epidemiology (Prof H C Gugnani PhD), Department of Microbiology (Prof H C Gugnani PhD), Saint James School of Medicine, The Valley, Anguilla; School of Dentistry, State University of Montes Claros, Montes Claros, Brazil (Prof A L S Guimaraes PhD); Department of Epidemiology, Healis Sekhsaria Institute for Public Health, Mumbai, India (P C Gupta DSc, D N Sinha PhD); Commissioner of Public Health, West Virginia Bureau for Public Health, Charleston, WV, USA (Prof R Gupta MD); Department of Health Policy, Management & Leadership, West Virginia University School of Public Health, Morgantown, WV, USA (Prof R Gupta MD); Academics and Research, Rajasthan University of Health Sciences, Jaipur, India (Prof R Gupta MD); Department of Preventive Cardiology, Eternal Heart Care Centre & Research Institute, Jaipur, India (Prof R Gupta MD); Department of Cardiology, Montefiore Medical Center, Bronx, NY, USA (T Gupta MD); Department of Epidemiology and Population Health (H Hosgood PhD), Albert Einstein College of Medicine, Bronx, NY, USA (T Gupta MD); Department of Epidemiology and Psychosocial Research, Ramón de la Fuente Muñiz National Institute of Psychiatry, Mexico City, Mexico (R A Gutiérrez PhD); Department of Public Health (B Gyawali MPH), National Centre for Register-based Research (Prof J J McGrath MD), Aarhus University, Aarhus, Denmark; Nepal Development Society, Pokhara, Nepal (B Gyawali MPH); Department of Public Health, Erasmus University Medical Center, Rotterdam, Netherlands (J A Haagsma PhD, S Kochhar MD, S Polinder MA); Department of Family and Community Medicine, Arabian Gulf University, Manama, Bahrain (Prof R R Hamadeh DPhil); School of Health and Environmental Studies, Hamdan Bin Mohammed Smart University, Dubai, United Arab Emirates (Prof S Hamidi DrPH); Population Health Department, University of New Mexico, Albuquerque, NM, USA (A J Handal PhD); Neurology Department, Sir Charles Gairdner Hospital, Perth, WA, Australia (Prof G J Hankey MD); Cardiology Department (Prof S Harikrishnan MD), Achutha Menon Centre for Health Science Studies (Prof P Jeemon PhD, G Mini PhD, Prof K R Thankappan MD), Neurology Department (Prof P Sylaja), Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, India; Research and Development Unit, San Juan de Dios Sanitary Park, Sant Boi De Llobregat, Spain (Prof J M Haro MD, S Tyrovolas PhD); Department of Medicine (Prof J M Haro MD), University of Barcelona, Barcelona, Spain (S Tyrovolas PhD); Public Health Department (L Jahangiry PhD), Tabriz University of Medical Sciences, Tabriz, Iran (H Hassankhani PhD); Independent Consultant, Tabriz, Iran (H Hassankhani PhD); Unit of Epidemiology and Social Medicine, University Hospital Antwerp, Wilrijk, Belgium (H Y Hassen MPH); Clinical Sciences Department, Karolinska University Hospital, Stockholm, Sweden (R Havmoeller PhD); International Foundation for Dermatology, London, UK (Prof R J Hay MD); Department of Environmental Health Engineering, Hormozgan University of Medical Sciences, Bandar Abbas, Iran (Prof M Heidari PhD); Department of Statistics and Econometrics, Bucharest University of Economic Studies, Bucharest, Romania (Prof C Herteliu PhD, Prof A Mirica PhD, A Pana MD); Department of Psychiatry, University Medical Center Groningen, Groningen, Netherlands (Prof H W Hoek MD); Department of Epidemiology (Prof H W Hoek MD), Department of Health and Behavior Studies (Prof I D Sigfusdottir PhD), Columbia University, New York, NY, USA; University of Texas - Austin, Austin, TX, USA (M K Hole MD); School of Health (Prof E Homaie Rad PhD), Guilan Road Trauma Research Center (Prof E Homaie Rad PhD), Guilan University of Medical Sciences, Rasht, Iran; Transdisciplinary Centre for Qualitative Methods, Manipal University, Manipal, India (A Pujar PhD, P Hoogar PhD); Department of Computer Science, University of Human Development, Sulaimaniyah, Iraq (M Hosseinzadeh PhD); Department of Internal Medicine, Bucharest Emergency Hospital, Bucharest, Romania (Prof M Hostiu PhD); Clinical Legal Medicine, National Institute of Legal Medicine Mina Minovici, Bucharest, Romania (Prof S Hostiu PhD); Department of Epidemiology and Health Statistics, Central South University, Changsha, China (Prof G Hu PhD); Institute of Community and Public Health, Birzeit University, Birzeit, Palestine (Prof A Hussein PhD); Health Sciences Department, Qatar University, Doha, Qatar (Prof A Hussein PhD); Infectious Diseases Department, Bashkir State Medical University, Ufa, Russia (B Idrisov MD); Department of Public Health and Community Medicine, University of Liberia, Monrovia, Liberia (O S Ilesanmi PhD); Global Health and Development Department (Prof U Iqbal PhD), Graduate Institute of Biomedical Informatics (D N A Ningrum MPH), Taipei Medical University, Taipei City, Taiwan; Institute for Physical Activity and Nutrition (S Islam PhD), School of Medicine (M Rahman PhD), Department of Psychology (Prof M A Stokes PhD), Deakin University, Burwood, VIC, Australia; Surveillance and Health Services Research, American Cancer Society, Atlanta, GA, USA (F Islami PhD); Department of Global and Community Health, George Mason University, Fairfax, VA, USA (K H Jacobsen PhD); Public Health Department, Tabriz University of Medical Sciences, Tabriz, Iran (L Jahangiry PhD); Department of Parasitic Diseases, National Centre for Disease Control Delhi, Delhi, India (S K Jain MD); Medical Sciences Department, University of Kragujevac, Kragujevac, Serbia (Prof M Jakovljevic PhD); Newcastle University, Tyne, UK (M Javanbakht PhD); Faculty of Graduate Studies (A U Jayatilake PhD), Institute of Medicine (A U Jayatilake PhD), University of Colombo, Colombo, Sri Lanka; Center for Applied Pediatric Quality Analytics, Boston Children's Hospital, Boston, MA, USA (K J Jenkins MD); Department of Community Medicine, Banaras Hindu University, Varanasi, India (R P Jha MSc); Beijing Institute of Ophthalmology, Beijing Tongren Hospital, Beijing, China (Prof J B Jonas MD); Centre for Community Medicine (Prof A Joshi MD, Prof A P Pakhare MD), Department of Paediatrics (Prof R Lodha MD), Department of Cardiology (Prof A Roy MD), Department of Psychiatry (Prof R Sagor MD), Department of Endocrinology, Metabolism, & Diabetes (Prof N Tandon PhD), All India Institute of Medical Sciences, New Delhi, India; Institution of Health and Nutrition Sciences, Czestochowa University of Technology, Czestochowa, Poland (Prof J J Jozwiak PhD); Faculty of Medicine and Health Sciences, University of Opole, Opole, Poland (Prof J J Jozwiak PhD); School of Health Sciences, Savitribai Phule Pune University, Pune, India (S B Jungari MA); Institute of Family Medicine and Public Health, University of Tartu, Tartu, Estonia (M Jürisson PhD); School of Public Health, University College Cork, Cork, Ireland (Z Kabir PhD); Department of Epidemiology (M Karami PhD), Department of Environmental Health Engineering (M Leili PhD), Chronic Diseases (Home Care) Research Center, Hamadan University of Medical Sciences, Hamadan, Iran (M Shamsizadeh MSc), Hamadan University of Medical Sciences, Hamadan, Iran; Department for Epidemiology, Helmholtz

Centre for Infection Research, Braunschweig, Germany (A Karch MD); Baqiyatallah Research Center for Gastroenterology and Liver Diseases (H Karimi-Sari MD), Student Research Committee (M Khosravi MD), Baqiyatallah University of Medical Sciences, Tehran, Iran; Department of Young Investigators, Middle East Liver Disease Center, Tehran, Iran (H Karimi-Sari MD); Department of Anesthesiology & Pain Medicine, Seattle Children's Hospital, Seattle, WA, USA (N J Kassebaum MD); MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, Glasgow, UK (S V Katikireddi PhD); School of Health Care Administration, Oklahoma State University, Tulsa, OK, USA (Prof A Kaul MD); Health Care Delivery Sciences, University of Tulsa, Tulsa, OK, USA (Prof A Kaul MD); Department of Epidemiology and Biostatistics (D S Kazi MD, Prof K M Mehta DSc), Department of Medicine (D S Kazi MD), University of California San Francisco, San Francisco, CA, USA; ODeL Campus (Prof P N Keyiyo PhD), School of Medicine (Prof G Yonga MD), University of Nairobi, Nairobi, Kenya (M Kumar PhD); Department of Linguistics and Germanic, Slavic, Asian, and African Languages, Michigan State University, East Lansing, MI, USA (G R Kemp BA); Non-communicable Diseases Research Unit (Prof A P Kengne PhD), Alcohol, Tobacco, & Other Drug Use Research Unit (Prof C D H Parry PhD), Cochrane South Africa (E Z Sambala PhD, Prof C S Wiysonge MD), Medical Research Council South Africa, Cape Town, South Africa; Department of Medicine (Prof A P Kengne PhD, G A Mensah MD, J Noubiap MD, Prof K Sliwa MD, Prof L J Zuhlke PhD), School of Public Health and Family Medicine (R Matzopoulos PhD), Department of Psychiatry and Mental Health (Prof D J Stein MD), Department of Paediatrics and Child Health (Prof L J Zuhlke PhD), University of Cape Town, Cape Town, South Africa; Institute of Cardiology, Assuta Hospital, Tel Aviv Yaffo, Israel (Prof A Keren MD); Heart Failure and Cardiomyopathies Center, Hadassah Hebrew University Hospital, Jerusalem, Israel (Prof A Keren MD); CSIR-Indian Institute of Toxicology Research, Council of Scientific & Industrial Research, Lucknow, India (C Kesavachandran PhD); Department of Public Health and Community Medicine, Jordan University of Science and Technology, Ramtha, Jordan (Prof Y S Khader PhD); Department of Statistics, Azad University, Omidyeh Branch, Iran (B Khafaei PhD); Epidemiology and Biostatistics Department, Health Services Academy, Islamabad, Pakistan (Prof E A Khan MPH); Department of Internal Medicine, John H. Stroger Jr Hospital of Cook County, Chicago, IL, USA (M S Khan MD); Department of Internal Medicine (M S Khan MD, T J Siddiqi MB, M S Usman MB), Dow University of Health Sciences, Karachi, Pakistan; Department of Epidemiology (G Naik MPH, J A Singh MD), Department of Medicine (P Ranjan PhD, J A Singh MD), Department of Psychology (D C Schwebel PhD), University of Alabama at Birmingham, Birmingham, AL, USA (M Khan MD, A R Sawant MD); University of Tennessee, Knoxville, TN, USA (M Khan MD); Institute of Health Policy and Management (Prof Y Khang MD), Department of Health Policy and Management (Prof Y Khang MD), Seoul National University, Seoul, South Korea; International Otorhinolaryngology Research Association, Tehran, Iran (M Khosravi MD); Department of Nutrition and Health Science, Ball State University, Muncie, IN, USA (Prof J Khubchandani PhD); Clinical Epidemiology Unit (A A Kiadaliri PhD), Department of Clinical Sciences (Prof B Norrving PhD), Lund University, Lund, Sweden; Kenya Revenue Authority, Nairobi, Kenya (D N Kiirithio MSc); Research and Data Solutions, Synotech Consultant, Nairobi, Kenya (D N Kiirithio MSc); Department of Health Sciences, Northeastern University, Boston, MA, USA (Prof D Kim DrPH); Department of Preventive Medicine, Korea University, Seoul, South Korea (Y Kim PhD, Prof S Yoon PhD); School of Medicine, Xiamen University Malaysia, Sepang, Malaysia (Prof Y Kim PhD); Department of Nutrition, Simmons College, Boston, MA, USA (R W Kimokoti MD); Faculty of Health, University of Canberra, Canberra, ACT, Australia (Y Kinfu PhD); Department of Health Management and Health Economics (Prof A Kisa PhD), Institute of Health and Society (A S Winkler PhD), University of Oslo, Oslo, Norway; Department of Global Community Health and Behavioral Sciences, Tulane University, New Orleans, LA, USA (Prof A Kisa PhD); Department of Health Economics and Social Security (K Kissimova-Skarbek PhD), Institute of Public Health (R Topor-Madry PhD), Jagiellonian University Medical College, Krakow, Poland; Department of Public Health (Prof M Kivimäki PhD, T Lallukka PhD), University of Helsinki, Helsinki, Finland (T J Meretoja MD); Department of Psychosocial Science (A S Knudsen PhD, Prof S Øverland PhD), Department of Global Public Health and Primary Care (Prof O F Norheim PhD), University of Bergen, Bergen, Norway; Public Health Sciences Division, Fred Hutchinson Cancer Research Center, Seattle, WA, USA (J M Kocarnik PhD); Department of Preventive Cardiology, National Cerebral and Cardiovascular Center, Suita, Japan (Prof Y Kokubo PhD); Arthritis Research Canada, Richmond, BC, Canada (J A Kopec PhD); Department of Internal and Pulmonary Medicine, Sheri Kashmir Institute of Medical Sciences, Srinagar, India (Prof P A Koul MD); Research Center of Neurology, Moscow, Russia (E V Gnedovskaya PhD, M A Kravchenko PhD); Department of Anthropology, Panjab University, Chandigarh, India (Prof K Krishan PhD); Department of Social and Preventive Medicine (Prof B Kuate Defo PhD), Department of Demography (Prof B Kuate Defo PhD), University of Montreal, Montreal, QC, Canada; Department of Public Health, Yuksek Ihtisas University, Ankara, Turkey (Prof B Kucuk Bicer BEP); Department of Public Health, Hacettepe University, Ankara, Turkey (Prof B Kucuk Bicer BEP); Population and Work Ability Program (T Lallukka PhD), Finnish Institute of Occupational Health, Helsinki, Finland (R Shiri PhD); Department of Community and Family Medicine (Prof F H Lami PhD), Assistant Professor of Epidemiology (Prof M Moradinazar PhD), Academy of Medical Science, Baghdad, Iraq; HelpMeSee, New York, NY, USA (Prof V C Lansingh PhD); Belo Horizonte City Hall, Municipal Health Department of Belo Horizonte, Belo Horizonte, Brazil (Prof S Lansky PhD); Relaciones Internacionales, Mexican Institute of Ophthalmology, Queretaro, Mexico (Prof V C Lansingh PhD); Department of Public Health (A Latifi PhD), Managerial Epidemiology Research Center (S Safiri PhD), Maragheh University of Medical Sciences, Maragheh, Iran; Department of Information and Internet Technologies, I M Sechenov First Moscow State Medical University, Moscow, Russia (Prof G Lebedev PhD, S K Vladimirov PhD); Central Research Institute of Cytology and Genetics (E Varavikova PhD) Federal Research Institute for Health Organization and Informatics of the Ministry of Health (FRIHOI), Moscow, Russia (Prof G Lebedev PhD, Prof V I Starodubov DSc, S K Vladimirov PhD); School of Nursing, Hong Kong Polytechnic University, Hong Kong, China (P H Lee PhD); Department of Clinical Research and Epidemiology, Shenzhen Sun Yat-sen Cardiovascular Hospital, Shenzhen, China (Prof Y Li PhD); National Office for Maternal and Child Health Surveillance, Chengdu, China (Prof J Liang MD, Prof Y Wang MD); National Center of Birth Defects Monitoring of China, Chengdu, China (Prof J Liang MD, Prof Y Wang MD); Department of Medicine, University of Malaya, Kuala Lumpur, Malaysia (L Lim MD); Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Shatin, China (L Lim MD); School of Public Health, University of Haifa, Haifa, Israel (Prof S Linn DrPH); Institute of Nutrition, Friedrich Schiller University Jena, Jena, Germany (Prof S Lorkowski PhD); Competence Cluster for Nutrition and Cardiovascular Health (NUTRICARD), Jena, Germany (Prof S Lorkowski PhD); General Surgery Department, Aintree University Hospital National Health Service Foundation Trust (NHS), Liverpool, UK (R Lunevicius PhD); Surgery Department, University of Liverpool, Liverpool, UK (R Lunevicius PhD); Saw Swee Hock School of Public Health (Prof S Ma PhD), Yong Loo Lin School of Medicine (Prof N Venketasubramanian MBBS), National University of Singapore, Singapore; Neurology Department (Prof M T Mackay PhD), Cardiology Department (Prof R G Weintraub MB), Royal Children's Hospital, Melbourne, VIC, Australia; Cardiology, Damiatta University, Damiatta, Egypt (H Magdy Abd El Razek MD); Ophthalmology Department, Aswan Faculty of Medicine, Aswan, Egypt (M Magdy Abd El Razek MB); Department of Internal Medicine, Grant Medical College & Sir J J Group of Hospitals, Mumbai, India (D P Maghavani MBBS); Department of Public Health, Trnava University, Trnava, Slovakia (Prof M Majdan PhD); Non-communicable Diseases Research Center, Shiraz University of Medical Sciences, Shiraz, Iran (Prof R Malekzadeh MD, S G Sepanlou MD); Surgery Department, Emergency University Hospital Bucharest, Bucharest, Romania (A Manda MD); Department of Economics, Autonomous Technology Institute of Mexico, Mexico City,

Mexico (Prof G Martinez PhD); Campus Caucaia, Federal Institute of Education, Science and Technology of Ceará, Caucaia, Brazil (F R Martins-Melo PhD); Clinical Institute of Medical and Chemical Laboratory Diagnostics, Medical University of Graz, Graz, Austria (Prof W März MD); Graduate School, University of the East Ramon Magsaysay Memorial Medical Center, Quezon City, Philippines (M B Marzan MSc); National Centre for Disease Informatics and Research (P Mathur PhD), Regional Medical Research Centre (S Pati MD), Indian Council of Medical Research, Bengaluru, India; Department of Biology and Biological Engineering, Chalmers University of Technology, Gothenburg, Sweden (M Mazidi PhD); Department of Ophthalmology, Hywel Dda University Health Board, Carmarthen, UK (C McAlinden PhD); Liver Disease and Hepatitis Program, Alaska Native Medical Center, Anchorage, AK, USA (B J McMahan MD); Research, Monitoring and Evaluation, Ipas Nepal, Kathmandu, Nepal (S Mehata PhD); Neurology Department, Janakpuri Super Specialty Hospital Society, New Delhi, India (Prof M Mehndiratta MD); Preventive Oncology, National Institute of Cancer Prevention and Research, Noida, India (Prof R Mehrotra PhD); Department of Internal Medicine, Sevenhills Hospital, Mumbai, India (V Mehta MD); Department of Public Health (T C Mekonnen MPH), Department of Pharmacy (G Mengistu MSc), Wollo University, Dessie, Ethiopia; College of Health Sciences, Debre Tabor University, Debre Tabor, Ethiopia (A Melese MSc); Department of Public Health, University of West Florida, Pensacola, FL, USA (Prof P T N Memiah DrPH); Peru Country Office, United Nations Population Fund (UNFPA), Lima, Peru (W Mendoza MD); Center for Translation Research and Implementation Science, National Institutes of Health, Bethesda, MD, USA (G A Mensah MD); Neurocenter (Prof A Meretoja MD), Breast Surgery Unit (T J Meretoja MD), Helsinki University Hospital, Helsinki, Finland; Clinical Microbiology and Parasitology Unit, Zagreb, Croatia (Prof T Mestrovic PhD); University Centre Varazdin, University North, Varazdin, Croatia (Prof T Mestrovic PhD); Department of Pharmacy, Ethiopian Academy of Medical Science, Mekelle, Ethiopia (Prof H B Mezgebe MSc); Department of Hypertension (Prof T Miazgowski MD), Zdroje Hospital (J Widecka PhD), Emergency Department (B Miazgowski MD), Pomeranian Medical University, Szczecin, Poland (B Miazgowski MD); Pacific Institute for Research & Evaluation, Calverton, MD, USA (T R Miller PhD); Nevada Division of Public and Behavioral Health, Carson City, NV, USA (M Mirarefin MPH); President's Office, National Institute of Statistics, Bucharest, Romania (Prof A Mirica PhD); Faculty of General Medicine, Kyrgyz State Medical Academy, Bishkek, Kyrgyzstan (Prof E M Mirrakhimov MD); Department of Atherosclerosis and Coronary Heart Disease, National Center of Cardiology and Internal Disease, Bishkek, Kyrgyzstan (Prof E M Mirrakhimov MD); Institute of Addiction Research (ISFF), Frankfurt University of Applied Sciences, Frankfurt, Germany (B Moazen MSc); Department of Biology, Salahaddin University, Erbil, Iraq (K A Mohammad PhD); Erbil, Ishik University, Erbil, Iraq (K A Mohammad PhD); Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran (N Mohammadifard PhD, Prof N Sarrafzadegan MD); Department of Public Health, Jigjiga University, Jigjiga, Ethiopia (M A Mohammed PhD); Health Systems and Policy Research Unit (S Mohammed PhD), Department of Community Medicine (M B Sufiyan MD), Ahmadu Bello University, Zaria, Nigeria; Department of Diabetology, Madras Diabetes Research Foundation, Chennai, India (V Mohan DSc); Clinical Epidemiology and Public Health Research Unit, Burlo Garofolo Institute for Maternal and Child Health, Trieste, Italy (L Monasta DSc, L Ronfani PhD); Department of Epidemiology and Biostatistics (Prof G Moradi PhD), Social Determinants of Health Research Center (Prof G Moradi PhD), Kurdistan University of Medical Sciences, Sanandaj, Iran; Lancaster University, Lancaster, UK (P Moraga PhD); International Laboratory for Air Quality and Health (Prof L Morawska PhD), Australian Centre for Health Services Innovation (R Pacella PhD), School of Exercise and Nutrition Sciences (Q G To PhD), Queensland University of Technology, Brisbane, QLD, Australia; Santo Antonio Hospital, Hospital Center of Porto, Porto, Portugal (J Morgado-Da-Costa MSc); 1st Department of Ophthalmology, General Hospital of Athens, University of Athens, Athens, Greece (Prof M M Moschos PhD); Biomedical Research Foundation, Academy of Athens, Athens, Greece (Prof M M Moschos PhD); Demographic Change and Ageing Research Area (A Werdecker PhD), Competence Center Mortality-follow-up (R Westerman PhD), 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 Endocrinology & Metabolism, Institute of Post Graduate Medical Education & Research, Kolkata, India (Prof S Mukhopadhyay MD); Department of Obstetrics and Gynecology, University of Jos, Jos, Nigeria (J Musa MD); Center for Global Health (J Musa MD), Department of Preventative Medicine (Prof Y Yano MD), Northwestern University, Chicago, IL, USA; School of Medical Sciences, Science University of Malaysia, Kubang Kerian, Malaysia (Prof K Musa PhD); Pediatrics Department, Nishtar Medical University, Multan, Pakistan (Prof G Mustafa MD); Pediatrics & Pediatric Pulmonology, Institute of Mother & Child Care, Multan, Pakistan (Prof G Mustafa MD); Department of Epidemiology, University of Pittsburgh, Pittsburgh, PA, USA (Prof J B Nachega PhD); Institute of Epidemiology and Medical Biometry, Ulm University, Ulm, Germany (Prof G Nagel PhD, Prof D Rothenbacher MD); Department of Pulmonary Medicine, Government Medical College Trivandrum, Trivandrum, India (Prof S Nair MD); Health Action by People, Trivandrum, India (Prof S Nair MD); Department of Dermatology, San Bortolo Hospital, Vicenza, Italy (Prof L Naldi MD); Direction, GISED Study Center, Bergamo, Italy (Prof L Naldi MD); Department of Preventive Medicine and Public Health, Chungnam National University School of Medicine, Daejeon, South Korea (Prof H Nam PhD); Daejeon Regional Cancer Center, Chungnam National University Hospital, Daejeon, South Korea (Prof H Nam PhD); Ophthalmology, Suraj Eye Institute, Nagpur, India (V Nangia MD); Department of Public Health (J Nansseu MD), Department of Internal Medicine and Specialties (Prof E Sobngwi PhD), University of Yaoundé I, Yaoundé, Cameroon; Department of Nephrology, Madras Medical College, Chennai, India (Prof G Natarajan BEP); Department of Cardiology, Cardio-aid, Bucharest, Romania (Prof R I Negoii PhD); Department of Neurosciences, Kenya Medical Research Institute/Wellcome Trust Research Programme, Kilifi, Kenya (Prof C R J Newton MD); Ministry of Health, Community Development, Gender, Elderly and Children, Dar Es Salaam, Tanzania (F N Ngalesoni PhD); Department of Biological Sciences, University of Embu, Embu, Kenya (J W Ngunjiri DrPH); Hanoi School of Public Health, Hanoi, Vietnam (A Q Nguyen PhD, H T Nguyen MSc, Prof H T Nguyen PhD); Public Health Science Department, State University of Semarang, Kota Semarang, Indonesia (D N A Ningrum MPH); National Department of Health, South African Embassy, Pretoria, South Africa (N Noluthshungu MD); Institute for Global Health Policy Research, National Center for Global Health and Medicine, Shinjuku-ku, Japan (Prof S Nomura MSc); University of Social Welfare and Rehabilitation Sciences, Iran (Prof M Noroozi PhD); Department of Preventive Medicine, Kyung Hee University, Dongdaemum-gu, South Korea (Prof I Oh PhD); Department of HIV/AIDS, STIs & TB, Human Sciences Research Council, Durban, South Africa (O Oladimeji MD); School of Public Health, University of Namibia, Oshakati Campus, Namibia (O Oladimeji MD); Department of Psychiatry, University of Lagos, Lagos, Nigeria (A T Olagunju MD); Centre for Healthy Start Initiative, Ikoyi, Nigeria (B O Olusanya PhD, J O Olusanya MBA); Institute of Health Science, University of Brunei Darussalam, Gadong, Brunei (S S Ong MBBS, FAMS); Graduate School of Public Health, San Diego State University, San Diego, CA, USA (Prof E Oren PhD); School of Psychology, University of Ottawa, Ottawa, ON, Canada (H M Orpana PhD); School of Medicine (Prof A Ortiz MD), Pneumology Service (Prof J B Soriano MD), Autonomous University of Madrid, Madrid, Spain; Nephrology and Hypertension Department, The Institute for Health Research Foundation Jiménez Díaz University Hospital, Madrid, Spain (Prof A Ortiz MD); Center for Vaccine Development (Prof J R Ortiz MD), School of Medicine (Prof M T Wallin MD), University of Maryland, Baltimore, MD, USA; The Center for Healthcare Quality Assessment and Control, Ministry of Health of the Russian Federation, Moscow, Russia (S S Ostavnov PhD); Moscow Institute of Physics and Technology, Moscow State University, Dolgoprudny, Russia (S S Ostavnov PhD); Occupational Health and Safety Department, Karabuk University, Karabük, Turkey (Prof R Özdemiir PhD); Department of TB & Respiratory Medicine,

Jagadguru Sri Shivarathreeswara University, Mysore, India (Prof M P A DNB); University of Chichester, Chichester, UK (R Pacella PhD); Department of Medicine, University of Ottawa, Ottawa, ON, Canada (S Pakhale MD); Center for Health Outcomes & Evaluation, Bucharest, Romania (A Pana MD); Department of Medical Humanities and Social Medicine, Kosin University, Busan, South Korea (Prof E Park PhD); Department of Medicine, Maimonides Medical Center, Brooklyn, NY, USA (S Patel MD); Clinical Research Department, Diabetes Research Society, Hyderabad, India (Prof V R Paturi MD); Clinical Research Department, Diabetomics, Portland, OR, USA (Prof V R Paturi MD); Cartagena University, Cartagena, Colombia (Prof D M Pereira PhD); Independent Consultant, Glenelg, SA, Australia (Prof K Pesudovs PhD); Institute of Medicine, University of Gothenburg, Gothenburg, Sweden (Prof M Petzold PhD); School of Public Health, University of Witwatersrand, Johannesburg, South Africa (Prof M Petzold PhD); Shanghai Mental Health Center, Shanghai Jiao Tong University, Shanghai, China (Prof M R Phillips MD); Basic Medical Sciences Department, Durban University of Technology, Durban, South Africa (Prof J D Pillay PhD); University Medical Center Groningen, University of Groningen, Groningen, Netherlands (Prof M J Postma PhD); Department of Nephrology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India (S Prakash PhD, Prof N Prasad MD); Non-communicable Diseases Research Center, Alborz University of Medical Sciences, Karaj, Iran (M Qorbani PhD); Department of Environmental & Occupational Health, Drexel University, Philadelphia, PA, USA (Prof D Quistberg PhD); Medichem, Barcelona, Spain (A Radfar MD); Epidemiology & Biostatistics, Contech School of Public Health, Lahore, Pakistan (A Rafay MS); Society for Health and Demographic Surveillance, Suri, India (R Rai MPH); Department of Economics, University of Göttingen, Göttingen, Germany (R Rai MPH); Medical University Innsbruck, Innsbruck, Austria (S Rajsic MD); Institute for Poverty Alleviation and International Development, Yonsei University, Nepal (C L Ranabhat PhD); University College London Hospitals, London, UK (D L Rawaf MD); Public Health England, London, UK (Prof S Rawaf PhD); Brien Holden Vision Institute, Sydney, NSW, Australia (Prof S Resnikoff MD); Organization for the Prevention of Blindness, Paris, France (Prof S Resnikoff MD); Department of Epidemiology, Birjand University of Medical Sciences, Iran (S Riahi PhD); Department of Clinical Research, Federal University of Uberlândia, Uberlândia, Brazil (L Roever PhD); Golestan Research Center of Gastroenterology and Hepatology, Golestan University of Medical Sciences, Gorgan, Iran (G Roshandel PhD); Biotechnology, Ikiam Amazon Regional University, Ciudad De Tena, Ecuador (E Rubagotti PhD); Department of Ocean Science and Engineering, Southern University of Science and Technology, Shenzhen, China (E Rubagotti PhD); Neuropsychiatric Institute, Prince of Wales Hospital, Randwick, NSW, Australia (Prof P S Sachdev MD); Medical Department, University of Sharjah, Sharjah, United Arab Emirates (Prof B Saddik PhD); Department of Medical Biotechnology, Mashhad University of Medical Sciences, Mashhad, Iran (Prof A Sahebkar PhD); College of Medicine, Al-Imam Mohammad Ibn Saud Islamic University, Riyadh, Saudi Arabia (N Salam PhD); School of Health and Policy Management, Faculty of Health, York University, Toronto, ON, Canada (Prof P Salamati MD); Institute of Scientific and Technological Communication and Information in Health, Oswaldo Cruz Foundation, Rio De Janeiro, Brazil (R D Saldanha MPH); Punjab University College of Pharmacy, Anarkali, Pakistan (Z Saleem PharmD); Clinical Research Division, Chest Research Foundation, Pune, India (Prof S S Salvi MD); Department of Entomology, Ain Shams University, Cairo, Egypt (A M Samy PhD); Department of Surgery, Marshall University, Huntington, WV, USA (Prof J Sanabria MD); Department of Nutrition and Preventive Medicine, Case Western Reserve University, Cleveland, OH, USA (Prof J Sanabria MD); Nephrology Group, Jimenez Diaz Foundation University Hospital Institute for Health Research, Madrid, Spain (M Sanchez-Niño PhD); Department of Public Health, Regional Health Administration Do Norte I P, Vila Nova De Gaia, Portugal (J V Santos MD); Department of Health and Society, Faculty of Medicine, University of Applied and Environmental Sciences, Bogotá, Colombia (Prof R Sarmiento-Suárez MPH); Department of Public Health Medicine, University of Kwazulu-natal, Durban, South Africa (Prof B Sartorius PhD); Surgery Department, Hamad Medical Corporation, Doha, Qatar (B Sathian PhD); Faculty of Health & Social Sciences, Bournemouth University, Bournemouth, UK (B Sathian PhD); UGC Centre of Advanced Study in Psychology, Utkal University, Bhubaneswar, India (Prof M Satpathy PhD); Udyam-Global Association for Sustainable Development, Bhubaneswar, India (Prof M Satpathy PhD); Department of Public Health Sciences, University of North Carolina at Charlotte, Charlotte, NC, USA (M Sawhney PhD); School of Health Sciences, Federal University of Santa Catarina, Araranguá, Brazil (Prof I J C Schneider PhD, Prof D A S Silva PhD); Hypertension in Africa Research Team (HART), North-West University, Potchefstroom, South Africa (Prof A E Schutte PhD); Department of Medical Statistics, Epidemiology and Medical Informatics, University of Zagreb, Zagreb, Croatia (M Sekerija PhD); Division of Epidemiology and Prevention of Chronic Noncommunicable Diseases, Croatian Institute of Public Health, Zagreb, Croatia (M Sekerija PhD); Langone Medical Center (A Shafieesabet MD), Institute of Environmental Medicine (Prof G D Thurston DSc), New York University, New York, NY, USA; Public Health Division, An-Najah National University, Nablus, Palestine (A A Shaheen PhD); Department of Laboratory Sciences (Prof M Sharif PhD), Department of Basic Sciences (Prof M Sharif PhD), Islamic Azad University, Sari, Iran; University School of Management and Entrepreneurship, Delhi Technological University, New Delhi, India (Prof R Sharma PhD); Independent Consultant, Karachi, Pakistan (M A Shaikh MD); Department of Pulmonary Medicine, Fudan University, Shanghai, China (J She MD); Usher Institute of Population Health Sciences and Informatics, University of Edinburgh, Edinburgh, UK (Prof A Sheikh MSc, I N Soyiri PhD); Friedman School of Nutrition Science and Policy, Tufts University, Boston, MA, USA (P Shi PhD); National Institute of Infectious Diseases, Tokyo, Japan (M Shigematsu PhD); Institute of Medical Epidemiology, Martin Luther University Halle-Wittenberg, Halle, Germany (I Shiue PhD); School of Health, University of Technology Sydney, Sydney, NSW, Australia (Prof S Siabani PhD); Department of Psychology, Reykjavik University, Reykjavik, Iceland (Prof I D Sigfusdottir PhD, R Sigurvinsdottir PhD); Department of Neurology, University of Pennsylvania, Philadelphia, PA, USA (D H Silberberg MD); Portuguese Institute of Sport and Youth, Lisbon, Portugal (N T D Silva MPsych); Brasília University, Brasília, Brazil (Prof D A Silveira MSc); Max Hospital, Ghaziabad, India (Prof N P Singh MD); Department of Policy Studies, The Energy and Resources Institute School of Advanced Studies (TERI), New Delhi, India (P K Singh PhD); Department of Pulmonary Medicine, Asthma Bhawan, Jaipur, India (Prof V Singh MD); Epidemiology, School of Preventive Oncology, Patna, India (D N Sinha PhD); Pediatric Department, King Khalid University Hospital, Riyadh, Saudi Arabia (Prof B H Sobaih MD); Department of Endocrinology and Diabetes, Yaounde Central Hospital, Yaounde, Cameroon (Prof E Sobngwi PhD); The Dartmouth Institute for Health Policy, Dartmouth College, Lebanon, NH, USA (Prof S S Soneji PhD); Service of Pulmonology, Health Research Institute of the University Hospital “de la Princesa”, Madrid, Spain (Prof J B Soriano MD); Clinical Neurological Sciences, The University of Western Ontario, London, ON, Canada (L A Sposato MD); Division of Community Medicine, International Medical University, Kuala Lumpur, Malaysia (Prof C T Sreeramareddy MD); Department of Occupational Therapy, Athens University of Applied Sciences, Athens, Greece (V Stathopoulou PhD); Department of Nursing, Muhammadiyah University of Surakarta, Kartasura, Indonesia (Prof A Sudaryanto MPH); School of Medicine, University of California Riverside, Riverside, CA, USA (P J Sur MPH); Department of Criminology, Law and Society, University of California Irvine, Irvine, CA, USA (Prof B L Sykes PhD); Department of Medicine (Prof R Tabarés-Seisdedos PhD), Department of Pediatrics, Obstetrics and Gynecology (Prof M Tortajada-Girbés PhD), University of Valencia, Valencia, Spain; Carlos III Health Institute, Biomedical Research Networking Center for Mental Health Network (CIBERSAM), Madrid, Spain (Prof R Tabarés-Seisdedos PhD); Cancer Control Center, Osaka International Cancer Institute, Osaka, Japan (T Tabuchi MD); Menzies Health Institute Queensland, Griffith University, Gold Coast, QLD, Australia (S K Tadakamadia PhD); Asbestos Diseases Research Institute, Sydney, NSW, Australia (Prof K Takahashi PhD); University Institute “Egas Moniz”, Monte Da

Caparica, Portugal (Prof N Taveira PhD); Research Institute for Medicines, Faculty of Pharmacy of Lisbon, University of Lisbon, Lisbon, Portugal (Prof N Taveira PhD); Anesthesiology Department, University of Virginia, Charlottesville, VA, USA (A S Terkawi MD); Syrian Expatriate Medical Association (SEMA), Charlottesville, VA, USA (A S Terkawi MD); Lee Kong Chian School of Medicine (Prof L Tudor Car PhD), Nanyang Technological University, Singapore, Singapore (S Thirunavukkarasu PhD); Department of Health Policy, National Center for Child Health and Development, Setagaya, Japan (Prof R Tobe-Gai PhD); Department Of Medicine, University of Calgary, Calgary, AB, Canada (Prof M Tonelli MD); Agency for Health Technology Assessment and Tariff System, Warszawa, Poland (R Topor-Madry PhD); Pediatric Department, University Hospital Doctor Peset, Valencia, Spain (Prof M Tortajada-Girbés PhD); Nutritional Epidemiology Research Team, National Institute of Health and Medical Research, Paris, France (M Touvier PhD); Department of Health Economics, Hanoi Medical University, Hanoi, Vietnam (Prof B X Tran PhD); Clinical Hematology and Toxicology, Military Medical University, Hanoi, Vietnam (K B Tran MD); King George's Medical University, Lucknow, India (S Tripathi MD); CV Medicine, Cleveland Clinic, Cleveland, OH, USA (Prof E Tuzcu MD); Cleveland Clinic Abu Dhabi, Abu Dhabi, United Arab Emirates (Prof E Tuzcu MD); Department of Internal Medicine, Federal Teaching Hospital, Abakaliki, Nigeria (K N Ukwaja MSc); Gomal Center of Biochemistry and Biotechnology, Gomal University, Dera Ismail Khan, Pakistan (I Ullah PhD); TB Culture Laboratory, Mufti Mehmood Memorial Teaching Hospital, Dera Ismail Khan, Pakistan (I Ullah PhD); School of Government, Pontifical Catholic University of Chile, Santiago, Chile (E A Undurraga PhD); Schneider Institutes for Health Policy, Brandeis University, Waltham, MA, USA (E A Undurraga PhD); Ankara University, Ankara, Turkey (S B Uzun MSc); Division of Cardiovascular Medicine, University of Louisville, Louisville, KY, USA (G Vaidya MD); President, Argentine Society of Medicine, Buenos Aires, Argentina (Prof P R Valdez MEd); Intensive Care Unit Staff, Velez Sarsfield Hospital, Buenos Aires, Argentina (Prof P R Valdez M Ed); UKK Institute, Tampere, Finland (Prof T J Vasankari MD); Raffles Neuroscience Centre, Raffles Hospital, Singapore (Prof N Venketasubramanian MBBS); Sport Science Department, University of Extremadura, Cáceres, Spain (S Villafaina MSc); Department of Medical and Surgical Sciences, University of Bologna, Bologna, Italy (Prof F S Violante MPH); Occupational Health Unit, Sant'orsola Malpighi Hospital, Bologna, Italy (Prof F S Violante MPH); Department of Health Care Management and Economics, National Research University Higher School of Economics, Moscow, Russia (Prof V Vlassov MD); Foundation University Medical College, Foundation University, Rawalpindi, Pakistan (Prof Y Waheed PhD); Department of Neurology, George Washington University, Washington, DC, USA (Prof M T Wallin MD); Independent Consultant, Staufenberg, Germany (A Werdecker PhD); Department of Research, Cancer Registry of Norway, Oslo, Norway (Prof E Weiderpass PhD); Department of Neurology, Technical University of Munich, Munich, Germany (A S Winkler PhD); Kailuan General Hospital, Kailuan General Hospital, Tangshan, China (Prof S Wu PhD); University of Strathclyde, Glasgow, UK (G M A Wyper MSc); Department of Pharmacology, St John's National Academy of Health Sciences, Bangalore, India (Prof D Xavier MD); School of Medicine, Nanjing University, Nanjing, China (Prof G Xu MD); Clinical Cancer Research Center, Milad General Hospital, Tehran, Iran (S Yahyazadeh Jabbari MD); Global Health Research Center, Duke Kunshan University, Kunshan, China (Prof L L Yan PhD); Department of Earth Science, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia (Y J Yasin MPH); Wolkite University, Wolkite, Ethiopia (A Yeshaneh BHLthSci); University of South Australia, Adelaide, NSW, Australia (B D Yirsaw PhD); Department of Biostatistics, Kyoto University, Kyoto, Japan (Prof N Yonemoto MPH); School of Public Health, University of Kinshasa, Kinshasa, Democratic Republic of the Congo (Prof M Yotebieng PhD); Department of Health Policy and Management, Jackson State University, Jackson, MS, USA (Prof M Z Younis DrPH); Tsinghua University, Tsinghua University, Beijing, China (Prof M Z Younis DrPH); Global Health Institute (Prof C Yu PhD), Department of Epidemiology and Biostatistics (Prof C Yu), Wuhan

University, Wuhan, China; Epidemiology and Cancer Registry Sector, Institute of Oncology Ljubljana, Ljubljana, Slovenia (Prof V Zadnik PhD); Department of Epidemiology, University Hospital of Setif, Setif, Algeria (Prof Z Zaidi PhD); Department of Epidemiology, Human Genetics and Environmental Sciences, University of Texas, Houston, TX, USA (K Zhang PhD); Noncommunicable Disease Control and Prevention Center, Chinese Center for Disease Control and Prevention, Beijing, China (M Zhou PhD).

Contributors

Please see appendix 1 for more detailed information about individual authors' contributions to the research, divided into the following categories: managing the estimation process; writing the first draft of the manuscript; providing data or critical feedback on data sources; developing methods or computational machinery; applying analytical methods to produce estimates; providing critical feedback on methods or results; drafting the work or revising it critically for important intellectual content; extracting, cleaning, or cataloguing data; designing or coding figures and tables; and managing the overall research enterprise.

Declaration of interests

Ettore Beghi reports personal fees from MA-Provider and grants from the Italian Ministry of Health, UCB-PHARMA, American ALS Association, EISAI, and Shire. Yannick Bejot reports grants and personal fees from AstraZeneca and Boehringer Ingelheim and personal fees from Daiichi-Sankyo, Bristol-Myers Squibb (BMS), Pfizer, Medtronic, Bayer, Novex pharma, and Merck Sharpe & Dohme (MSD). Adam Berman reports personal fees from Philips. Louisa Degenhardt reports grants from Indivior, Mundipharma, and Seqirus. Panniyammakal Jeemon reports a Clinical and Public Health Intermediate Fellowship from the Wellcome Trust-DBT India Alliance (2015-20). Jacek Jóźwiak reports a grant from Valeant, personal fees from Valeant, ALAB Laboratoria and Amgen, and non-financial support from Microlife and Servier. Nicholas Kassebaum reports personal fees and other support from Vifor Pharmaceuticals. Srinivasa Vittal Katikireddi reports grants from NHS Research Scotland, the Medical Research Council, and the Scottish Government Chief Scientist Office. Jeffrey Lazarus reports personal fees from Janssen and CEPHEID and grants and personal fees from AbbVie, Gilead Sciences, and MSD. Stefan Lorkowski reports personal fees from Amgen, Berlin-Chemie, MSD, Novo Nordisk, Sanofi-Aventis, Synlab, Unilever, and non-financial support from Preventicus. Winfried März reports grants and personal fees from Siemens Diagnostics, Aegerion Pharmaceuticals, Amgen, AstraZeneca, Danone Research, Pfizer, BASF, Numares, and Berline-Chemie; personal fees from Hoffmann LaRoche, MSD, Sanofi, and Syngeva; grants from Abbott Diagnostics; and other support from Synlab. Walter Mendoza is currently a Program Analyst for Population and Development at the Peru Country Office of the United Nations Population Fund. Ted Miller reports an evaluation contract from AB InBev Foundation. Frédéric Piel reports personal fees from Novartis. Postma Maarten reports grants from Mundipharma, Bayer, BMS, AstraZeneca, ARTEG, and Asca; grants and personal fees from Sigma Tau, MSD, GlaxoSmithKline, Pfizer, Boehringer-Ingelheim, Novavax, Ingress Health, AbbVie, and Sanofi; personal fees from Quintiles, Astellas, Mapi, OptumInsight, Novartis, Swedish Orphan, Innoval, Jansen, Intercept, and Pharmerit, and stock ownership in Ingress Health and Pharmacoeconomics Advice Groningen. Kazem Rahimi reports grants from the National Institute for Health Research Biomedical Research Centre, Economic and Social Research Council, and Oxford Martin School. Mark Shrimme reports grants from Mercy Ships and Damon Runyon Cancer Research Foundation. Jasvinder Singh reports consulting for Horizon, Fidia, UBM, Medscape, WebMD, the National Institutes of Health, and the American College of Rheumatology; they serve as the principal investigator for an investigator-initiated study funded by Horizon pharmaceuticals through a grant to DINORA, a 501c3 entity; they are on the steering committee of OMERACT, an international organization that develops measures for clinical trials and receives arms-length funding from 36 pharmaceutical companies. Jeffrey Stanaway reports a grant from Merck & Co. Cassandra Szoeké reports a grant from the National Medical Health Research Council, Lundbeck, Alzheimer's Association, and the Royal Australasian College of Practitioners; she holds patent PCT/AU2008/001556. Amanda Thrift reports grants from National Health and Medical Research Council, Australia. Muthiah Vaduganathan

receives research support from the NIH/National Heart, Lung, and Blood Institute and serves as a consultant for Bayer and Baxter Healthcare. Marcel Yotebieng reports grants from the US National Institutes of Health. All other authors declare no competing interests.

Data sharing

To download the data used in these analyses, please visit the Global Health Data Exchange at <http://ghdx.healthdata.org/gbd-2017>.

Acknowledgments

Research reported in this publication was supported by the Bill & Melinda Gates Foundation, the University of Melbourne, Public Health England, the Norwegian Institute of Public Health, St Jude Children's Research Hospital, the National Institute on Ageing of the National Institutes of Health (award P30AG047845), and the National Institute of Mental Health of the National Institutes of Health (award R01MH110163). 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 United States Agency for International Development (USAID). Views expressed do not necessarily reflect those of USAID, the US Government, or MEASURE Evaluation. Collection of these data was made possible by USAID under the terms of cooperative agreement GPO-A-00-08-000_D3-00. The opinions expressed are those of the authors and do not necessarily reflect the views of USAID or the US Government. The data reported here have been supplied by the US Renal Data System. 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.

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