

Findings from the Global Burden of Disease Study 2021

Christopher J L Murray, for the GBD 2021 Collaborators



In *The Lancet*, we have published the findings of the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2021 in a series of six Articles.^{1–6} GBD began in 1991 and has continued over the past three decades to provide a comprehensive empirical assessment of health around the world.⁷ With each iteration GBD has become more detailed, including more causes, risks, and locations, improving granularity of age group analyses, and has enabled the completion of extension studies, such as forecasting studies and estimations of the burden of antimicrobial resistance.^{8–14} This greater detail has been possible because of the large increase in primary data sources, with 328 938 different sources used in GBD 2021, enabling the calculation of more than 607 billion estimates. However, notably, many data gaps remain in low-resource settings. The publication of the high-level summary of our findings across these six Articles provides readers with a summary of the most notable trends and main dimensions of disparity across groups based on age, sex, location, and sociodemographic index globally. In GBD 2021, the impact of the COVID-19 pandemic, through myriad mechanisms, is a central theme, but GBD reminds us that other macro trends have continued even as the world has gone through a major health shock. Our Article on forecasts⁶ for GBD also highlights that future trends might be quite different to past trends because of factors such as the obesity epidemic, the increase in substance-use disorders, and climate change, while also underlining the tremendous opportunities to alter the trajectory of health for the next generation.

COVID-19 has been the largest setback in global health over the past 71 years, as measured by life expectancy.¹ Global life expectancy decreased by 1.6 years (95% uncertainty interval [UI] 1.0–2.2) between 2019 and 2021, and country-specific changes in life expectancy over the same period were substantial, with the greatest decreases seen in Peru, with a 6.5 year (5.0–8.1) decline;¹ only 32 (16%) of 204 countries and territories had increases in life expectancy between 2019 and 2021. In countries with complete or nearly complete civil registration and vital statistics data, we have a very detailed understanding of the effects of COVID-19 in 2020 and 2021, the first 2 years of the pandemic, including larger increases in mortality in males than in females alongside continued reductions in mortality rates in children younger than 5 years in most countries. But because of inadequate data systems and huge lags in alternative measurement methods for age-specific and cause-specific mortality, controversy remains about the true impact of COVID-19 in sub-Saharan Africa. For instance, the Civil Registration and Vital Statistics system in South Africa showed large

increases in mortality rates in older age groups during the pandemic;^{1,3} however, Health and Demographic Surveillance Sites in the country have largely not reported on the effects of the COVID-19 pandemic even as of January, 2024.³ Preliminary all-cause mortality reporting from countries such as Canada, Finland, Japan, and Australia suggests much larger than expected increases in mortality in 2022 and 2023. Wide heterogeneity of the number of cases and deaths caused by COVID-19 and long lags in reporting mean that the full impact of the pandemic might not be known for several years. The next iterations of GBD (GBD 2023 and GBD 2024), coming over the next 2 years, will hopefully provide an increasingly complete accounting of the pandemic.

Despite data limitations, we have a good understanding of the long-term trends at least in age-specific mortality for the world. GBD provides an examination of demographic trends from 1950 onwards, of causes of death from 1980 onwards, and of the full health impacts of diseases and risk factors from 1990 onwards at the country level and at the subnational level for 21 countries. Over the past 70 years, the world has had remarkably sustained progress in lowering mortality for both children and adults. Life expectancy increased by 22.7 years (95% UI 20.8–24.8) between 1950 and 2021.¹ There have been major global setbacks, such as the increase in adult mortality in former Soviet Union territories in eastern Europe and central Asia in the 1990s, the sharp increase in adult mortality in countries most greatly affected by the HIV epidemic before the roll-out of antiretroviral therapy, and the more focal impact of conflict and natural disasters, such as the genocide in Rwanda in 1994, the tsunami in the Indian Ocean in 2004, and the Haitian earthquake in 2010. Between 1950 and 2021, the world has seen major decreases in deaths due to infectious disease, particularly among children, driven by improvements in sanitation, the delivery of specific interventions (eg, childhood vaccinations), and increased access to effective health care. From 1950—the first year for which GBD estimates life expectancy—until the beginning of the COVID-19 pandemic, longevity for populations across the world generally improved with increasing educational attainment, increasing income per person, and remarkable technical innovation in health-enhancing products and methods of delivery.

The reversal of the trends in life expectancy due to the COVID-19 pandemic has been remarkable given the nearly continuous pace of progress at the global scale otherwise seen over nearly seven decades. The pandemic, which affected populations across nations and within nations heterogeneously, is also a stark reminder that health gains are precarious. One cannot assume that

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Institute for Health Metrics and Evaluation and Department of Health Metrics Sciences, School of Medicine, University of Washington, Seattle, WA, USA

(Prof C J L Murray DPhil)

Correspondence to: Prof Christopher J L Murray, Institute for Health Metrics and Evaluation, University of Washington, Seattle, WA 98195, USA
cjl@uw.edu

For more on short-term mortality fluctuations see <https://www.mortality.org/Data/STMF>

To view and download estimates from the GBD 2021 study see <https://vizhub.healthdata.org/gbd-results/>

To explore estimates of the world's health using the data visualisation tool see <https://vizhub.healthdata.org/gbd-compare/>

because progress has been made it will continue, particularly if health programmes go unfunded or are undercut by geopolitical forces, alongside the slowing of the research and development pipeline. To maintain progress, we need continued vigilance, adequate health workforces, policy makers who adapt to new situations, and proactive strategies to deal with new threats as they emerge.¹⁵

Even before the COVID-19 pandemic, warning signs of new challenges emerged in high-income countries. The steady and seemingly inexorable decrease in cardiovascular disease mortality had stopped or even reversed in several countries.³ This observation is likely driven by the increase of obesity and the associated increase in fasting plasma glucose. More general slowdowns in the progress that has been made in reducing mortality have also been driven in some countries by an increase in opioid deaths, particularly from fentanyl overdoses.⁵ Long-term trends in these behaviours risk limiting future progress, or at least slowing progress, compared with what might have been. Furthermore, other global threats, such as antimicrobial resistance, bioterrorism fuelled by malicious use of artificial intelligence, and climate change and its myriad effects, including increasing food insecurity in heat-stressed environments, continue to threaten to derail the general trends of progress. However, misinformation and political polarisation makes it even harder to sustain progress in health.

In this iteration of GBD, considerable attention was devoted to trends in age-specific and total fertility from 1950 to 2021 and forecasted to 2100.² The world has had an incredible fertility transition leading to most countries having total fertility rates below the replacement level of 2.1 children per woman. Driven by increases in women's education, needs met with modern contraceptive methods, urbanisation, and lower child mortality, fertility rates can drop rapidly. Our analyses suggest that as women become more educated and reproductive health services become more widely available, the completed cohort fertility rate (ie, the average number of children born during childbearing years to females from a specified birth cohort) is projected to decrease to 1.4 or less.² Sustained low fertility is followed in most countries by decreases in total population a generation later, unless countries pursue liberal migration policies. Some 110 countries were estimated to have total fertility rates below the replacement level in 2021, increasing to a projected 155 countries by 2050. Some nations will manage the fiscal, economic, and social challenges of inverted population pyramids by encouraging migration, while others will resist. There are concerns that some governments will attempt to pressure women to stay at home and have more children or even restrict women's reproductive rights as a mechanism to increase birth rates, as was done in Romania in the 1960s to 1980s, at great cost to maternal and child health, labour markets, and educational outcomes.¹⁶ The global community must

be vigilant about these changes and advocate wherever necessary to solve declining population numbers through other strategies.

By contrast, slow decreases or the beginning of decreases in estimated total fertility rates in western sub-Saharan Africa—from 6.94 (95% UI 6.62–7.25) in 1950, to 4.29 (4.03–4.58) in 2021, and 2.72 (2.32–3.15) in 2050—mean that the total population for the whole of sub-Saharan Africa will probably continue to grow, potentially until the end of the century.² Climate stress, increasing educational attainment, and efforts to give women access to reproductive health services might accelerate the decline in fertility. However, if fertility in this region does not decrease much sooner and faster than forecasted, the number of people exposed to severe climate stress, resource and political instability, high child mortality rates, and poverty in the Sahel region might increase substantially. The contrast between sustained low fertility in the rest of the world and above-replacement fertility in many countries in sub-Saharan Africa means there will be a demographic imbalance. Many countries are likely to seek or have large immigration of African populations during this century. Efforts to make this migration pattern a success for the individuals and households migrating, and the communities to which they are migrating, is an opportunity for a win-win scenario.¹⁷

The Articles in our series on causes of death,³ disability-adjusted life-years (DALYs),⁴ and risk factors⁵ together highlight the complex pattern of disease burden across the world beyond the COVID-19 shock. The classic shifts that accompany the epidemiological transition are well documented, with ever larger shares of the burden of disease due to non-communicable diseases (NCDs) and injuries in all regions. In addition to these general shifts, we observed many secondary transformations. First, high BMI and high fasting plasma glucose continue to rise, and the associated prevalence of diabetes is increasing.¹⁸ Notably, because of wider accessibility of interventions, the trajectory for diabetes mortality seems to be more complex, with diabetes deaths decreasing in some countries that have increasing prevalence. Other risks that need urgent attention because their burden is worsening, or their burden is large and not improving, include high systolic blood pressure, sugar-sweetened beverage consumption, low physical activity, and drug use. Drug use is a key contributor to the increase in mortality both before and during the COVID-19 pandemic in select countries, such as the USA.⁵ Second, ambient particulate matter air pollution remains a major cause of attributable DALYs and is rising on the global scale, with much of this increase occurring in south Asia. Third, driven by the COVID-19 pandemic, depressive disorders and anxiety disorders have increased substantially. Fourth, child mortality steadily declined from 1990 to 2021, including during the COVID-19 pandemic. This decline is in sharp contrast to early predictions during the

For summaries of results for each cause, injury, and risk factor see <https://www.healthdata.org/research-analysis/diseases-injuries-risks/factsheets>

COVID-19 pandemic that child mortality would surge.¹⁹ This disconnect between early modelling studies and the empirical findings is a reminder that purely hypothetical modelling studies must be interpreted with caution.²⁰ Finally, the spatial pattern of self-harm and interpersonal violence is highly heterogeneous across locations, with some countries and territories having three orders of magnitude higher rates than others.³

GBD 2021 is the first iteration of GBD where we have profiled the related Burden of Proof studies,²¹ which provide a new star rating for the strength of evidence on the relationship between risks and specific outcomes. In the Burden of Proof studies, we statistically examine all the available studies on different pairs of risk factors and health outcomes, such as smoking and lung cancer,²² diet low in vegetables and type 2 diabetes,²³ and high systolic blood pressure and ischaemic heart disease.²⁴ We then assign a star rating to show how strong the link is between the two. A five-star rating means there is very strong evidence that the risk factor and health outcome are connected, while a one-star rating means there is not enough evidence to determine if there is an association between the two. While we have assessed 211 risk–outcome pairs, 123 risk–outcome pairs remain to be evaluated. With each future iteration of GBD, we expect more of the Burden of Proof analyses will be published and incorporated into the GBD analysis.

GBD 2021 includes comprehensive forecasts of the burden of disease through to 2050.⁶ The reference scenario, a probabilistic forecast of what is most likely to occur, incorporates all the GBD risk factors. Care has also been taken to include the most direct effects of climate change by incorporating increased daily temperature (and decreases in cold-related deaths) into the model. For the reference scenario, we adopted the Intergovernmental Panel on Climate Change’s “middle of the road” Shared Socioeconomic Pathways (known as SSPs) 2–4.5 scenario²⁵ as the most plausible trajectory for greenhouse gas emissions and global mean surface temperature increases. Our reference forecasts also include the related trajectory for particulate matter pollution (PM_{2.5}), which is probably affected by greenhouse gas mitigation. Despite the rising burden due to climate change, BMI, high fasting plasma glucose, drug use, and, in some places, PM_{2.5}, we expect life expectancy and healthy life expectancy to increase up to 2050.⁶ This progress in the face of many challenges is very encouraging, and there is reason for more optimism than routinely appears in the media. However, the expected progress is fragile, and many global threats might derail it. The *Lancet* Commission on 21st-Century Global Threats to Health²⁶ is working to quantify, or at least characterise, some of these major potential threats, including climate change, through a multiplicity of pathways, such as food insecurity, pandemics, antimicrobial resistance, nuclear escalation of conflicts, malicious use of artificial intelligence, and the increase in diabetes, obesity, addiction, and ageing.

The Article on forecasting disease burden⁶ also provides a high-level blueprint on how we can change the trajectory of health over the next generation. Huge opportunities exist to greatly reduce future burden and accelerate gains in healthy life expectancy, particularly if major NCD risks are addressed. The analysis quantifies the potential, but not the exact mechanism, by which key risk factors can be addressed. Although professionally researched packages of policies to reduce tobacco consumption are available, the policy package needed to reduce BMI is less clear. The success of GLP-1 agonists in achieving sustained weight loss in trials might suggest one route,^{27,28} but much more research is needed to understand the potential to address dietary risk factors at the population level, and across the sociodemographic spectrum. According to GBD 2021, there are effectively three key risk factors that need to be addressed to have a major impact: tobacco consumption, high BMI, and high blood pressure. As national health system leaders consider the potential to reduce NCD risks in their countries, strategies to address these major risk factors (and other NCD risks that are quantified in our forecasting study⁶) should feature prominently in national debates.

Declaration of interests

I declare no competing interests.

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For the Burden of Proof studies collection hub see <https://www.nature.com/collections/begeihaij>

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