Population Health Metrics

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The global burden of disease study and *Population Health Metrics*

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Abstract

This year marked the launch of the Global Burden of Disease (GBD) 2021 study, the first presentation of the study to incorporate the devastating direct, and indirect, worldwide impacts from the COVID-19 pandemic on population health. Understanding how the study differs from its predecessors is important to inform the innumerable secondary research opportunities from its use. *Population Health Metrics* prioritise the appraisal of innovative GBD research that moves the dial beyond reporting population health trends already available from the variety of publicly available GBD data visualisations and tools.

Burden of disease studies remain a prominent area of research that contribute towards *Population Health Metrics* achieving its aim of publishing research that informs advances in the science of population health assessment internationally, nationally, and locally. It also remains important that we appraise the gaps in the GBD study, particularly those which are potentially of high impact in policy-influencing discussions. Innovative local and national research has an important role to play in influencing the development of the future GBD study, as well as research which utilises GBD estimates in innovative ways to achieve positive policy impact.

Keywords Burden of Disease, Population Health Metrics, Global Durden of Disease, GBD

Background

This year marked the launch of the Global Burden of Disease (GBD) 2021 study which includes estimates of a wide range of population health metrics, stratified by demographic groups, across 1990 through 2021 for: 371 diseases and injuries; 3,499 sequelae; 9 impairments; 88 risk factors; across 204 countries and territories [1–3]. It is the first presentation of GBD estimates to incorporate the devastating direct, and indirect, worldwide impacts from the COVID-19 pandemic on population health. It comes somewhat later than the usual schedule due to the necessity of retrieving, processing, and synthesising data and intelligence from existing and novel systems and sources whilst acknowledging and navigating lags in data availability. The public release of GBD 2021 demonstrates confidence from the GBD Scientific Council that the estimates now reflect a credible understanding of the initial impact of the COVID-19 pandemic on population health.

Key innovations of GBD 2021

The strapline difference between GBD 2021 and previous study iterations is that GBD 2021 is the first to quantify the devastating, and unequal, impacts from the COVID-19 pandemic on population health worldwide. Underpinning this depth is improved coverage of data input sources across a greater variety of countries, with estimates now available for an increased number of causes of disease, risk factors, and demographic groups (Table 1). However, the most impactful changes lie beneath the hood, and relate to the complex methodological

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Table 1 Summary of additions in the GBD 2021 study

Area	Additional for GBD 2021
Causes of disease and injury	12 additional causes: • COVID-19 • Other COVID-19 pandemic related outcomes* • Pulmonary arterial hypertension • Hepatoblastoma • Burkitt lymphoma • Other non-Hodgkin lymphoma • Eye cancer • Retinoblastoma • Soft tissue and other extraosseous sarcomas • Malignant neoplasm of bone and articular cartilage • Neuroblastoma • Other peripheral nervous cell tumours
Risk factors	One additional risk factor: • Nitrogen dioxide pollution
Demographic groups	Increased disaggregation of the under 5 years age-group to: • 1 to 5 months • 6 to 11 months • 12 to 23 months • 2 to 4 years

* GBD 2021 defines other COVID-19 pandemic related outcomes as a fatal-only component, representing: "all excess deaths due to the COVID-19 pandemic that are not attributable to SARS-CoV-2 infection, after attributing all other excess deaths to known causes. It may include deaths associated with deferred care-seeking or other societal, economic, or behavioural changes tied to the pandemic, but which we could not attribute to a specific cause."

procedures implemented to capture the effects on population health from the COVID-19 pandemic.

The COVID-19 pandemic has had differential, and complex, impacts that needed to be integrated to produce credible estimates. These factors not only include the direct effects of COVID-19 but also incorporate an estimation of pandemic-related excess mortality to account for indirect pandemic effects from adverse impacts such as: decreases in economic prosperity; increases in poverty and unemployment; and from deferred, delayed, or absent health-related care [4, 5]. Actions to reduce the direct harms to health from COVID-19 through the implementation of public health measures and restrictions, as well as changing individual social-mixing behaviours, had positive and negative impacts on a wide range of other health outcomes, leading to complex mixed effects on-top of increased competition between underlying causes of death brought from the emergence of COVID-19; a novel cause of death occurring in a high frequency in vulnerable population sub-groups. In GBD 2021, the direct impacts are represented by COVID-19 as a new cause of disease, with the indirect mortality effects represented as a residual cause – other COVID-19 pandemic-related outcomes [4]. Future iterations of the GBD study will endeavour to redistribute and allocate these deaths to specific, and more meaningful, causes of death to increase their implications for policy action.

Research mobilising GBD estimates

Recently, the editors-in-chief of *Population Health Metrics* reiterated that research papers providing bona fide, and innovative, uses of estimates from the GBD study make highly relevant journal submissions [6]. The depth of the GBD 2021 study affords innumerable secondary research opportunities that are in scope for *Population Health Metrics*, conditional on moving beyond reporting trends already routinely available from the variety of GBD data visualisations and tools hosted by the Institute of Health Metrics and Evaluation. Innovative examples include, but are not restricted to, linkage to other data sources from health and health-influencing disciplines to explore: (i) the drivers of population-level disease burdens; (ii) the extent to which population health metrics are attributable to risks, including their associated health and wider economic costs; and (iii) whether existing, or proposed, changes to policies, interventions, healthcare services, and workforces, are adequate to improve and tackle population health losses.

The GBD study is renowned for its promotion of the concept of disability-adjusted life years (DALYs), which offer a comparative framework to measure the comprehensive impact of diseases, injuries, and risks in preventing populations from living longer lives in better health. However, the GBD study also generates estimates of many other central population health measures, such as prevalence and incidence, that tell us how many people are living with health conditions, and at what rate new cases are occurring. Research which mobilises the vast number of population health measures available in GBD 2021 can also help researchers construct a more meaningful and policy-relevant narrative. Whilst metrics such as DALYs are popular for developing strategic approaches

to tackling population health, traditional population health metrics such as incidence and prevalence remain vital to give insights into likely needs for, and demands on, health services. Through linking to external data sources such as workforce headcounts and related cost data, assessments of associations between metrics from the GBD study and linked measures can produce innovative, and actionable, research to influence policy discussions. Previous country-specific research provides inspiration of how burden of disease estimates can be utilised alongside other contextually important indicators. For example, cost data has been used to benchmark and correlate with disease burden estimates to provide evidence to inform short- and long-term public health and health service decision making in Norway [7].

Furthermore, the GBD 2021 study offers important opportunities for advancing insights into population health from the cross-pollination of epidemiology and health-related disciplines such as demography; two closely linked disciplines. Many high-income countries in the later stages of demographic transition are increasingly battling fiscal and public sector service sustainability issues which influence population health outcomes, so such research would provide policy-impactful findings.

Influencing future GBD study iterations

When estimating non-fatal disease burdens the main parameters required are the occurrence of diseases, and their associated disability weights. Disability weights are represented at the granular level of different health states, whereas metrics on the occurrence of diseases are often only available at a much higher level, for example the level of an individual health condition. The mapping of prevalence estimates to disability weights is most often achieved through severity distributions, which summarise the proportional distribution of each sequela within a cause of disease or injury. Given the comprehensive nature of estimating the occurrence of each disease and injury, estimating the occurrence of morbidity at sequelae level presents major challenges. In recent years, the GBD team has begun to take important strides to overcome previous shortcomings in non-fatal disease burden estimates by accounting for disease severity variations over time, and between, countries for anxiety and low back pain [8–10]. These advances allow estimates to capture much greater heterogeneity and disparities in the health-related impacts of living with the consequences of ill-health and give us a better opportunity to understand where we can take action to support particularly vulnerable sub-populations. Many national researchers are more readily placed and able to utilise the best available country-specific data at a lower granularity than the GBD study. Given the paucity of data in this area, research on the generation of context-specific severity distributions and across-country variations has the potential to be highly relevant for influencing policy, and guiding improvements in future iterations of the GBD study.

Promoting primary research that could influence improvements in future iterations of the GBD study remains essential. National burden of disease (NBD) studies provide a potential route of indirectly achieving this goal. Whilst the initial motivation of an NBD study may not be to influence future advances within the GBD study, often those undertaking this type of research have access to more granular data, from unpublished data sources. This type of research is often carried out by public health institutes that are an authoritative voice of population health metrics within their region.

Many opportunities exist to advance our scientific knowledge of the health impact of risks to population health. With the advent and development of the burden of proof study, the GBD study seeks to improve transparency over uncertainties in estimates and strength of evidence [11]. The burden of proof tool can be used to identify risk-outcome pairs where existing evidence is weak, or lacking, and can therefore be used to highlight where new research to strengthen the evidence base should be prioritised. Furthermore, the advent of the burden of proof study allows for a focus on the areas outlined hereafter, affording the potential for novel and meaningful advances in assessing the health impacts of risks, which is considered relevant for *Population Health Metrics*.

Due to the nature and powerful impact of COVID-19, the GBD 2021 study group was unable to attribute population health losses from COVID-19 to any of its 88 risk factors. However, the study has been used to attribute changes in depression and anxiety to the COVID-19 pandemic [12]. Our shared understanding of the direct impact of COVID-19 was that it did not impact populations equally due to pre-existing risk exposures and inequalities in the wider determinants of health [13, 14]. Studies in this area are not only key to our understanding of vulnerability to more severe outcomes from COVID-19 but are required to ensure comparability across time when assessing the health impact of metabolic, environmental, and behavioural risk exposures from the GBD study. *Population Health Metrics* considers this an important area which could assist future iterations of the GBD study to improve their estimation processes.

When applying the public health river analogy to GBD 2021, the main strengths of the study lie downstream. The study provides important intelligence and opportunities to assess the impact of clinical risks and health-harming products such as tobacco, alcohol, and unhealthy food commodities. However, we have long known that the wider circumstances in which people live – including social, economic, cultural, and environmental

factors – are fundamental in influencing the prevalence of these risk exposures, and outcomes, which lie further downstream [15]. The GBD study includes several environmental risks of high public health importance such as: air pollution, sub-optimal temperature, occupational hazards and poor water quality. However, there remains a key blind-spot in attributing health outcomes to the risks arising from the unequal distribution of power, wealth, and resources, which challenge using the estimates from the GBD study for policy-influencing discussions. There are advances in some areas, such as estimating the impact of education on population health outcomes [16]. Some examples of pivotal research exploring the impact of the wider determinants of health on all-cause, and cause-specific, disease burdens can be found from countries such as Denmark, Norway, and Scotland [17, 18].

Whilst generating evidence of the causal relationship between upstream factors and health outcomes presents difficulties, recent epidemiological advances in causal modelling and mediation analyses present opportunities to decompose how much downstream risks are influenced by upstream risks, and the contribution which remains unexplained, which can give important insights for equitable policy decisions. *Population Health Metrics* welcomes research of this type. We underscore its necessity in maintaining an equilibrium in research outputs not only to frame the magnitude of problems but to inform how to best mitigate through solutions that address upstream and downstream drivers of health.

Reporting estimates from burden of disease studies

Recently, *Population Health* Metrics published the inaugural Standardised Reporting of Burden of Disease studies (STROBOD) statement [19]. The STROBOD statement is a 28-item checklist for researchers to deploy when reporting burden of disease research from GBD and NBD studies in a consistent and transparent manner. The application of the statement can help inform the critical appraisal of published research, providing an important educational means for readers to better understand the complexity of study design choices when estimating DALYs.

Conclusion

The overarching goal of *Population Health Metrics* is to publish research that informs advances in the science of population health assessment internationally, nationally, and locally. GBD and NBD studies are prosperous resources that can be used to help us achieve that aim. It also remains important that we appraise the gaps in the GBD study, particularly those which are potentially of high impact in policy-influencing discussions. Innovative local and national research has an important role to play in influencing the development of the future GBD study, as well as research which utilises GBD estimates in innovative ways to achieve positive policy impact.

Abbreviations

DALYs	Disability-adjusted life years
GBD	Global Burden of Disease
NBD	National Burden of Disease

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Author contributions

GMAW prepared the initial draft of the manuscript. Feedback on this initial draft was received, and appraised, from the Editors-in-Chief of Population Health Metrics. The manuscript was finalised by GMAW.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Competing interests

The author of this paper is an Associate Editor of Population Health Metrics.

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