

# Global, regional, and national burden of low back pain, 1990–2020, its attributable risk factors, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021

**Author:**

Ferreira, ML; de Luca, K; Haile, LM; Steinmetz, JD; Culbreth, GT; Cross, M; Kopec, JA; Ferreira, PH; Blyth, FM; ... Keshri, Vikash

**Publication details:**

The Lancet Rheumatology

v. 5

Chapter No. 6

Medium: Electronic-eCollection

pp. e316 - e329

2665-9913 (ISSN)

**Publication Date:**

2023-06-01

**Publisher DOI:**

[https://doi.org/10.1016/S2665-9913\(23\)00098-X](https://doi.org/10.1016/S2665-9913(23)00098-X)

Downloaded from [http://hdl.handle.net/1959.4/unsworks\\_84364](http://hdl.handle.net/1959.4/unsworks_84364) in <https://unsworks.unsw.edu.au> on 2024-05-18



# Global, regional, and national burden of low back pain, 1990–2020, its attributable risk factors, and projections to 2050: a systematic analysis of the Global Burden of Disease Study 2021



GBD 2021 Low Back Pain Collaborators\*

*Lancet Rheumatol* 2023;  
5: e316–29

\*Collaborators are listed at the end of the Article

Correspondence to:  
Prof Manuela L Ferreira,  
Sydney Musculoskeletal Health  
and The Kolling Institute, School  
of Health Sciences, Faculty of  
Medicine and Health,  
The University of Sydney,  
NSW 2065, Australia  
manuela.ferreira@sydney.edu.au

## Summary

**Background** Low back pain is highly prevalent and the main cause of years lived with disability (YLDs). We present the most up-to-date global, regional, and national data on prevalence and YLDs for low back pain from the Global Burden of Diseases, Injuries, and Risk Factors Study 2021.

**Methods** Population-based studies from 1980 to 2019 identified in a systematic review, international surveys, US medical claims data, and dataset contributions by collaborators were used to estimate the prevalence and YLDs for low back pain from 1990 to 2020, for 204 countries and territories. Low back pain was defined as pain between the 12th ribs and the gluteal folds that lasted a day or more; input data using alternative definitions were adjusted in a network meta-regression analysis. Nested Bayesian meta-regression models were used to estimate prevalence and YLDs by age, sex, year, and location. Prevalence was projected to 2050 by running a regression on prevalence rates using Socio-demographic Index as a predictor, then multiplying them by projected population estimates.

**Findings** In 2020, low back pain affected 619 million (95% uncertainty interval 554–694) people globally, with a projection of 843 million (759–933) prevalent cases by 2050. In 2020, the global age-standardised rate of YLDs was 832 per 100 000 (578–1070). Between 1990 and 2020, age-standardised rates of prevalence and YLDs decreased by 10·4% (10·9–10·0) and 10·5% (11·1–10·0), respectively. A total of 38·8% (28·7–47·0) of YLDs were attributed to occupational factors, smoking, and high BMI.

**Interpretation** Low back pain remains the leading cause of YLDs globally, and in 2020, there were more than half a billion prevalent cases of low back pain worldwide. While age-standardised rates have decreased modestly over the past three decades, it is projected that globally in 2050, more than 800 million people will have low back pain. Challenges persist in obtaining primary country-level data on low back pain, and there is an urgent need for more high-quality, primary, country-level data on both prevalence and severity distributions to improve accuracy and monitor change.

**Funding** Bill and Melinda Gates Foundation.

**Copyright** © 2023 The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY 4.0 license.

## Introduction

The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) systematically quantifies health loss due to diseases and injuries by age, sex, year, and geographical location, and allows for the comparison of burden across disparate diseases.<sup>1</sup> Previous GBD low back pain estimates<sup>2–4</sup> confirmed that low back pain is the leading cause of disability in most countries. It is expected that both the total disability burden and disease-related costs will further increase in the coming decades.<sup>5</sup>

In response, global efforts have been made to provide clearer directions for change in policy and practice and to support the use of evidence-based management and prevention.<sup>5–8</sup> In 2018, *The Lancet* published a three-part Series on the definition, best-evidence-based treatment, and future research directions for low back pain. The

Series highlighted the roles of advice and education that support self-management, physical, and psychological interventions, especially as first-line treatments for low back pain.<sup>5,7,8</sup> However, there is still inappropriately high usage of imaging, prescribed bed rest, opioids, spinal injections, and other invasive procedures of questionable efficacy worldwide.<sup>8</sup> Paradoxically, the use of treatments of no or little efficacy can delay recovery and potentially increase the risk of long-term back-related disability, and consequently increase the burden of this condition globally.

In the current report we present global, regional, and national-level estimates of prevalence and years lived with disability (YLDs) of low back pain in the general population. Estimates are reported in terms of numbers (count) and age-standardised rates, by age and sex, for 204 countries

## Research in context

### Evidence before this study

The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) is a source of global, regional, and country-level estimates of disease burden over time. Input data are identified through systematic review in addition to US medical claims data. In 2017, it was estimated that over 551 million people were affected by low back pain, which was ranked the highest contributor to disability burden worldwide. To date, there is no published projection of the global prevalence of low back pain.

### Added value of this study

The current analysis includes estimates from 1990 to 2020 with updated bias adjustments and prevalence projections through to 2050. In 2020, it was estimated that 619 million (95% uncertainty interval 554 to 694) people reported having low back pain globally. Between 1990 and 2020, there was a decrease in age-standardised rates of prevalence (−10.4%; −10.9 to −10.0) and years lived with disability

(−10.5%; −11.1 to −10.0). Modifiable GBD risk factors, including occupational ergonomic factors, smoking, and high BMI, explained 38.8% (28.7 to 47.0) of years lived with disability. Prevalence projections for low back pain suggest that in 2050, there will be 843 million (759 to 933) individuals worldwide with low back pain, a 36.4% (29.9 to 43.2) increase from 2020.

### Implications of all the available evidence

Low back pain continues to be the greatest cause of disability burden worldwide, and two-fifths of this burden has been attributed to modifiable risk factors. The decade 2020–30 has been designated the “United Nations Decade of Healthy Ageing”, and this initiative provides a strong platform to strengthen national, regional, and global health initiatives to decrease the burden of low back pain through public awareness campaigns and recommendations to keep active.

and territories, from 1990 to 2020. We also highlight the relative contribution of occupational factors, smoking, and high BMI to the prevalence and burden of low back pain and present projections of cases for 2030–50.

## Methods

### Overview

This manuscript was produced as part of the GBD Collaborator Network and in accordance with the GBD Protocol.<sup>3</sup> GBD 2021 estimated low back pain prevalence and YLDs, by age and sex, for 204 countries and territories, from 1990 to 2020. The GBD study adheres to the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) statement.<sup>10</sup> Detailed methodology for the GBD study is reported elsewhere.<sup>1</sup>

### Case definition

The case definition for low back pain was pain in the posterior aspect of the body from the lower margin of the 12th ribs to the lower gluteal folds, with or without pain referred into one or both lower limbs, and lasting for at least 1 day.<sup>3</sup>

### Input data

Data were identified via systematic review of the literature of the electronic databases Ovid MEDLINE, Embase, and CINAHL, opportunistic searches, searches of government and international organisation websites, published reports, demographic and health surveys, and contributions of datasets by GBD collaborators. A systematic review of literature between 1980 and 2017 was updated on Oct 31, 2017, using the search terms “back pain”, “lumbar pain”, “back ache”, “backache”, and “lumbago” in combination with the terms “prevalence”, “incidence”, “cross-sectional”, and “epidemiology”, and on

Oct 31, 2019, by searching PubMed using the terms “back pain”, “prevalence”, and “incidence”. Systematic reviews are not updated for all causes of disease in each GBD cycle, but rather updated on a rotational basis. There were no restrictions on age, sex, or language (appendix p 2). In the 2017 review, a total of eight new data sources were included, yielding a total of 19 studies. In 2019, 35 new sources were included, yielding a total of 455 citations (please see the GBD 2019 Data Input Sources Tool). In 2020, 36 additional sources of data on non-fatal low back pain were added (appendix pp 7–11). Moreover, surveys such as the World Health and Community Oriented Program for Control Of Rheumatic Diseases (COPCORD) surveys were included. In addition to literature data, US medical claims data from 2000 and 2010–17 were included based on ICD-9 and ICD-10 coding. The reference ICD-10 codes used to identify cases of low back pain were M54.3 (sciatica), M54.4 (lumbago with sciatica), and M54.5 (low back pain). The ICD-9 code was 724 (low back pain).

Each data source was given a unique identifier and included in the Global Health Data Exchange. Members of the core Institute of Health Metrics and Evaluation (IHME) research team for this topic area had full access to the underlying data used to generate estimates presented in this paper. All other authors had access to, and reviewed, estimates as part of the GBD and research evaluation process, which includes additional stages of internal IHME and external formal collaborator review. The global distribution of data sources of low back pain is presented in the appendix (p 29).

### Data processing and disease modelling

Before fitting models, data reported for wide age ranges and male and female sexes combined were split by age

See Online for appendix

For the GBD 2019 Data Input Sources Tool see <https://ghdx.healthdata.org/gbd-2019/data-input-sources>

and sex. Sex-splitting and age data adjustments are described in the appendix (p 3). Data from studies that did not report sex-specific information were split based on a pooling of within-study sex ratios in a meta-regression tool, MR-BRT (meta-regression—Bayesian, regularised, trimmed; details described elsewhere<sup>1</sup>). The female-to-male ratio was 1.19 (95% uncertainty interval [UI] 1.03–1.40). Data that were reported in broad age groups (>25 years) were split into 5-year age groups by applying the age pattern estimated for low back pain in GBD 2019.

Data from sources that reported low back pain using alternative definitions (including studies that reported recall periods of 1 week to 1 month, recall periods between 1 month and 1 year, US claims data, and activity-limiting low back pain) were adjusted to the reference case definition. Bias adjustments were performed using MR-BRT. Adjustment factors were obtained by matching data with different case definitions by age, sex, year, and location and estimating the logit difference between the prevalence of the different case definitions in an MR-BRT network analysis, which leveraged matching pairs of data for two or more alternative case definitions (adjustment factors shown in appendix p 33). After adjustment, data with an age-standardised median absolute deviation of 1.5 or more above the mean prevalence by sex and location were considered outliers and excluded to ensure data that were implausibly high were not included in the analysis. The threshold of 1.5 or more above the mean prevalence was selected, given that outliers usually lie beyond 3 standard deviations from the mean.

A Bayesian meta-regression tool (DisMod-MR 2.1<sup>1</sup>) was used to generate estimates of prevalence by age, sex, location, and year. It was assumed there was no incident or prevalent low back pain before the age of 5 years. UIs were calculated by taking the 2.5th and 97.5th percentiles of the distribution of 1000 model runs after convergence.

Following this, estimates for low back pain were split by severity and presence of leg pain, based on proportions derived from Medical Expenditure Panel Surveys and US medical claims data (appendix p 36). Six different levels of severity were used for low back pain, two of which corresponded to health states with and without leg pain; each health state is linked to a disability weight (appendix p 35). The disability weight of each health state was multiplied by the corresponding age-sex-location-year-specific prevalence to calculate YLDs, which were adjusted based on co-occurrence of different diseases (details described elsewhere<sup>1</sup>). Global, regional (seven super-regions and 21 regions), and national prevalence and burden of disability rates are presented. GBD methodology does not attribute any increased mortality to low back pain in the current modelling. While low back pain might be part of the causal pathway for deaths (eg, opioid overdose), each death in GBD methodology can only be counted once and would be attributed to other causes. Therefore, our modelling results in

identical estimates for disability-adjusted life-years and YLDs; thus, the burden of disability is reported as YLDs.

### Risk estimation

Occupational ergonomic factors, high BMI, and smoking were the risk factors included in GBD 2021 for which there was probable evidence of risk–outcome pairs (ie, more than one study type, at least two cohorts, no substantial and unexplained heterogeneity, low risk of confounding and selection bias, biologically acceptable dose–response gradients<sup>11</sup>). High BMI was defined as being greater than its theoretical minimum risk exposure level (ie, the level associated with the lowest risk as 20–25 kg/m<sup>2</sup>).<sup>11</sup> Occupational ergonomic exposures were used as a proxy for lifting, forceful movements, awkward postures, and vibration, as specific data for these factors were not available for each country.<sup>12</sup> Low back pain relative risks were derived from published population-representative data sources. Identified risk factors were encompassed in a summary exposure value (a normalised summary measure of all risk factors linked to a condition) that was used as a covariate to fit a DisMod-MR 2.1 model for the prevalence of low back pain. The summary exposure value compares the distribution of excess risk-exposure level to a population at maximum risk.

### Estimate projections

Forecast global and regional cases of low back pain to the year 2050 were computed by forecasting prevalence and population estimates.<sup>13</sup> For low back pain, age-location-sex-specific GBD 2019 prevalence estimates from 1990 to 2020 were logit transformed and used in the following regression model:

$$E[\text{logit}(Y_{l,a,s,y})] = \beta_1 \text{SDI} + \alpha_{l,a,s}$$

The term on the left side of the equation is the forecasted logit(prevalence),  $\beta_1$  is the fixed coefficient on Socio-demographic Index (SDI; a composite indicator of a country's lag-distributed income per capita, average years of schooling for those older than 15 years, and the total fertility rate of women aged 25 years or younger) over time, and  $\alpha_{l,a,s}$  is the location-age-sex-specific random intercept. To obtain forecasted cases, forecasted rates were multiplied by forecasted population counts.<sup>13</sup> Forecasted prevalence rates were intercept-shifted to GBD 2021 prevalence by subtracting forecasted estimation year 2020 prevalence rates from GBD 2021 estimation year 2020 prevalence rates and using this difference to shift all forecasted values through to the year 2050. A Das Gupta decomposition analysis was performed to determine the relative contributions to the change in case number between 2020 and 2050 of population growth, population ageing, and changes in prevalence unrelated to demographics.<sup>14</sup> Validation testing was conducted using estimates from 1990 to 2010 to project prevalence from 2010 to 2019 by age, sex,

	Number of prevalent cases	Age-standardised prevalence rate per 100 000	Percentage change in age-standardised prevalence rate from 1990 to 2020	Number of YLDs	Age-standardised rate of YLDs per 100 000	Percentage change in age-standardised rate of YLDs per 100 000 from 1990 to 2020
Global	619 000 000 (554 000 000 to 694 000 000)	7460 (6690 to 8370)	-10.4% (-10.9 to -10.0)	69 000 000 (47 900 000 to 88 900 000)	832.0 (578.0 to 1070.0)	-10.5% (-11.1 to -10.0)
Central Europe, eastern Europe, and central Asia	60 300 000 (53 800 000 to 67 100 000)	11 200 (10 100 to 12 600)	-4.7% (-5.3 to -4.2)	6 690 000 (4 690 000 to 8 730 000)	1250.0 (873.0 to 1620.0)	-4.5% (-5.2 to -3.9)
Central Asia	8 050 000 (7 050 000 to 9 120 000)	9110 (8080 to 10 200)	-1.1% (-2.7 to 0.5)	910 000 (633 000 to 1 200 000)	1020.0 (710.0 to 1320.0)	-1.1% (-3.2 to 0.8)
Central Europe	20 300 000 (18 200 000 to 22 600 000)	12 800 (11 500 to 14 400)	-2.5% (-3.4 to -1.6)	2 260 000 (1 590 000 to 2 970 000)	1440.0 (1000.0 to 1870.0)	-2.1% (-3.1 to -1.1)
Eastern Europe	31 900 000 (28 400 000 to 35 600 000)	11 200 (10 100 to 12 500)	-3.9% (-4.7 to -2.9)	3 520 000 (2 480 000 to 4 600 000)	1240.0 (865.0 to 1600.0)	-3.8% (-4.8 to -2.6)
High-income	144 000 000 (131 000 000 to 156 000 000)	9880 (9000 to 10 900)	-4.2% (-5.9 to -2.5)	16 000 000 (11 100 000 to 20 700 000)	1100.0 (768.0 to 1410.0)	-4.7% (-6.3 to -3.1)
Australasia	4 130 000 (3 650 000 to 4 650 000)	11 100 (9710 to 12 600)	-5.8% (-9.1 to -2.2)	460 000 (320 000 to 590 000)	1240.0 (861.0 to 1580.0)	-5.6% (-9.5 to -1.7)
High-income Asia Pacific	26 500 000 (23 700 000 to 29 300 000)	9690 (8590 to 10 900)	-7.7% (-8.8 to -6.5)	2 970 000 (2 050 000 to 3 930 000)	1100.0 (762.0 to 1420.0)	-7.5% (-8.6 to -6.1)
High-income North America	48 600 000 (45 200 000 to 51 600 000)	10 500 (9900 to 11 200)	-5.8% (-11.3 to -0.7)	5 320 000 (3 800 000 to 6 790 000)	1160.0 (816.0 to 1470.0)	-7.0% (-12.5 to -2.3)
Southern Latin America	7 080 000 (6 290 000 to 7 950 000)	9280 (8240 to 10 500)	1.7% (-1.1 to 5.3)	791 000 (550 000 to 1 010 000)	1040.0 (723.0 to 1320.0)	1.3% (-1.4 to 5.1)
Western Europe	57 900 000 (51 500 000 to 64 000 000)	9510 (8480 to 10 700)	-2.2% (-4.3 to -0.5)	6 410 000 (4 450 000 to 8 420 000)	1070.0 (737.0 to 1360.0)	-2.3% (-4.3 to -0.6)
Latin America and Caribbean	48 800 000 (43 100 000 to 55 100 000)	7860 (6960 to 8850)	1.9% (1.3 to 2.8)	5 430 000 (3 760 000 to 6 970 000)	874.0 (605.0 to 1120.0)	1.7% (0.8 to 2.7)
Andean Latin America	3 610 000 (3 240 000 to 4 070 000)	5750 (5180 to 6460)	0.6% (-1.9 to 3.3)	405 000 (280 000 to 511 000)	644.0 (446.0 to 813.0)	0.2% (-2.6 to 3.2)
Caribbean	3 030 000 (2 700 000 to 3 360 000)	5950 (5300 to 6600)	-1.0% (-3.0 to 1.1)	338 000 (237 000 to 433 000)	664.0 (465.0 to 845.0)	-1.5% (-3.5 to 0.3)
Central Latin America	19 300 000 (17 100 000 to 21 900 000)	7480 (6640 to 8450)	1.2% (-0.2 to 2.5)	2 160 000 (1 490 000 to 2 770 000)	835.0 (576.0 to 1070.0)	1.2% (-0.2 to 2.9)
Tropical Latin America	22 800 000 (20 200 000 to 25 800 000)	9190 (8130 to 10 400)	3.2% (2.0 to 4.4)	2 530 000 (1 750 000 to 3 260 000)	1020.0 (704.0 to 1300.0)	2.9% (1.5 to 4.3)
North Africa and Middle East	50 500 000 (44 600 000 to 57 500 000)	8720 (7770 to 9780)	-2.0% (-3.1 to -0.8)	5 640 000 (3 900 000 to 7 300 000)	967.0 (670.0 to 1240.0)	-2.6% (-3.9 to -1.3)
South Asia	117 000 000 (103 000 000 to 134 000 000)	6950 (6170 to 7910)	-10.4% (-11.5 to -9.4)	13 000 000 (9 050 000 to 16 700 000)	765.0 (534.0 to 988.0)	-10.0% (-11.2 to -9.2)
Southeast Asia, east Asia, and Oceania	146 000 000 (129 000 000 to 164 000 000)	5560 (4970 to 6260)	-14.5% (-15.4 to -13.4)	16 500 000 (11 400 000 to 21 600 000)	627.0 (433.0 to 809.0)	-14.3% (-15.4 to -13.3)
East Asia	104 000 000 (92 600 000 to 117 000 000)	5430 (4870 to 6110)	-18.5% (-19.8 to -17.0)	11 800 000 (8 180 000 to 15 500 000)	614.0 (423.0 to 794.0)	-18.3% (-19.8 to -17.0)
Oceania	653 000 (565 000 to 750 000)	6340 (5550 to 7140)	-0.8% (-4.0 to 2.7)	73 800 (51 400 to 97 100)	707.0 (493.0 to 916.0)	-0.8% (-3.9 to 3.0)
Southeast Asia	40 700 000 (35 800 000 to 46 600 000)	5880 (5230 to 6650)	-1.5% (-2.4 to -0.2)	4 610 000 (3 190 000 to 5 990 000)	661.0 (458.0 to 850.0)	-1.2% (-2.3 to 0.4)
Sub-Saharan Africa	52 100 000 (45 700 000 to 59 000 000)	7180 (6410 to 8020)	-3.0% (-3.4 to -2.5)	5 840 000 (4 040 000 to 7 540 000)	796.0 (554.0 to 1030.0)	-2.6% (-3.2 to -2.0)
Central sub-Saharan Africa	6 490 000 (5 720 000 to 7 400 000)	7480 (6700 to 8400)	-3.4% (-6.2 to -1.0)	723 000 (503 000 to 937 000)	824.0 (577.0 to 1060.0)	-2.9% (-6.1 to -0.7)
Eastern sub-Saharan Africa	20 300 000 (17 800 000 to 22 900 000)	7600 (6800 to 8460)	-3.5% (-4.3 to -2.7)	2 270 000 (1 580 000 to 2 940 000)	843.0 (587.0 to 1090.0)	-2.9% (-3.9 to -1.9)
Southern sub-Saharan Africa	4 520 000 (3 990 000 to 5 140 000)	6510 (5800 to 7310)	-4.8% (-5.8 to -3.8)	500 000 (346 000 to 648 000)	714.0 (494.0 to 929.0)	-5.7% (-7.0 to -4.1)
Western sub-Saharan Africa	20 900 000 (18 200 000 to 23 700 000)	6890 (6130 to 7700)	-2.5% (-3.2 to -1.9)	2 340 000 (1 620 000 to 3 030 000)	766.0 (532.0 to 991.0)	-2.1% (-2.8 to -1.3)

Data in parentheses are 95% uncertainty intervals. Region and super-region numbers do not sum to the global prevalence due to rounding. YLDs=years lived with disability.

**Table 1: Prevalence, YLDs, age-standardised rates of prevalence and YLDs per 100 000 population in 2020, and percentage change between 1990 and 2020 for low back pain globally, by GBD regions and super-regions**

location, and year. The projections were then compared with the GBD prevalence results for this period by calculating the summary root mean squared error (RMSE) and bias. Bias was calculated as the median value of all predicted minus observed values by age, sex, location, and year. In all the four tests the model RMSE was less than 0.01 and bias was less than 0.0001.

**Role of the funding source**

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

**Results**

In 2020, the number of prevalent cases of low back pain globally was estimated at 619 million (95% UI 554–694; table 1), a substantial increase (60.4%; 57.1–64.2) from the 1990 aggregates for all ages and male and female sexes combined. The global age-standardised rate of prevalence of low back pain in 2020 was 7460 per 100 000 (6690–8370), representing a decrease of 10.4% (10.9–10.0) from 1990 (age-standardised rate 8330; 7470–9360). Globally, in 1990 low back pain accounted for 43.4 million (30.5–57.9) YLDs, for all ages and male and female sexes combined, representing 7.7% (6.4–8.7) of all-cause YLDs. In 2020, there were 69.0 million (47.9–88.9) low back pain YLDs, and although a slight decrease from 1990 in the percentage of all-cause YLDs

worldwide (8.1%; 6.7–9.5), low back pain was still the main contributor to YLDs globally. Of the 21 GBD regions, the highest age-standardised rate of prevalence per 100 000 individuals for low back pain was found in central Europe (12 800; 11 500–14 400), followed by eastern Europe (11 200; 10 100–12 500) and Australasia (11 100; 9710–12 600), with east Asia presenting the lowest age-standardised rates of prevalence (5430; 4870–6110; table 1).

Age-standardised rates of low back pain prevalence for 204 countries and territories in 2020 are found in figure 1 and in the appendix (pp 37–52). The nations with the highest age-standardised rates of prevalence per 100 000 were Hungary (14 000; 95% UI 12 600 to 15 500) followed by Czechia (13 100; 11 600 to 14 700), whereas the ones with the lowest age-standardised rates of prevalence were Maldives (5050; 4460 to 5730) and Myanmar (5090; 4530 to 5780). China had the largest percentage decrease in age-standardised rates of prevalence (–19.4%; –20.7 to –18.0) and YLDs (–19.3%; –20.8 to –17.8) per 100 000 between 1990 and 2020 (appendix pp 37–52). The largest increase in age-standardised rate of prevalence (19.4%; 12.1 to 27.2) and YLDs (20.0%; 12.5 to 28.4) was seen in Sweden (appendix pp 37–52).

Global prevalence rates were higher among females compared with males (figure 2) across all age groups, although more marked differences were observed at older age groups (ie, >75 years of age). The global

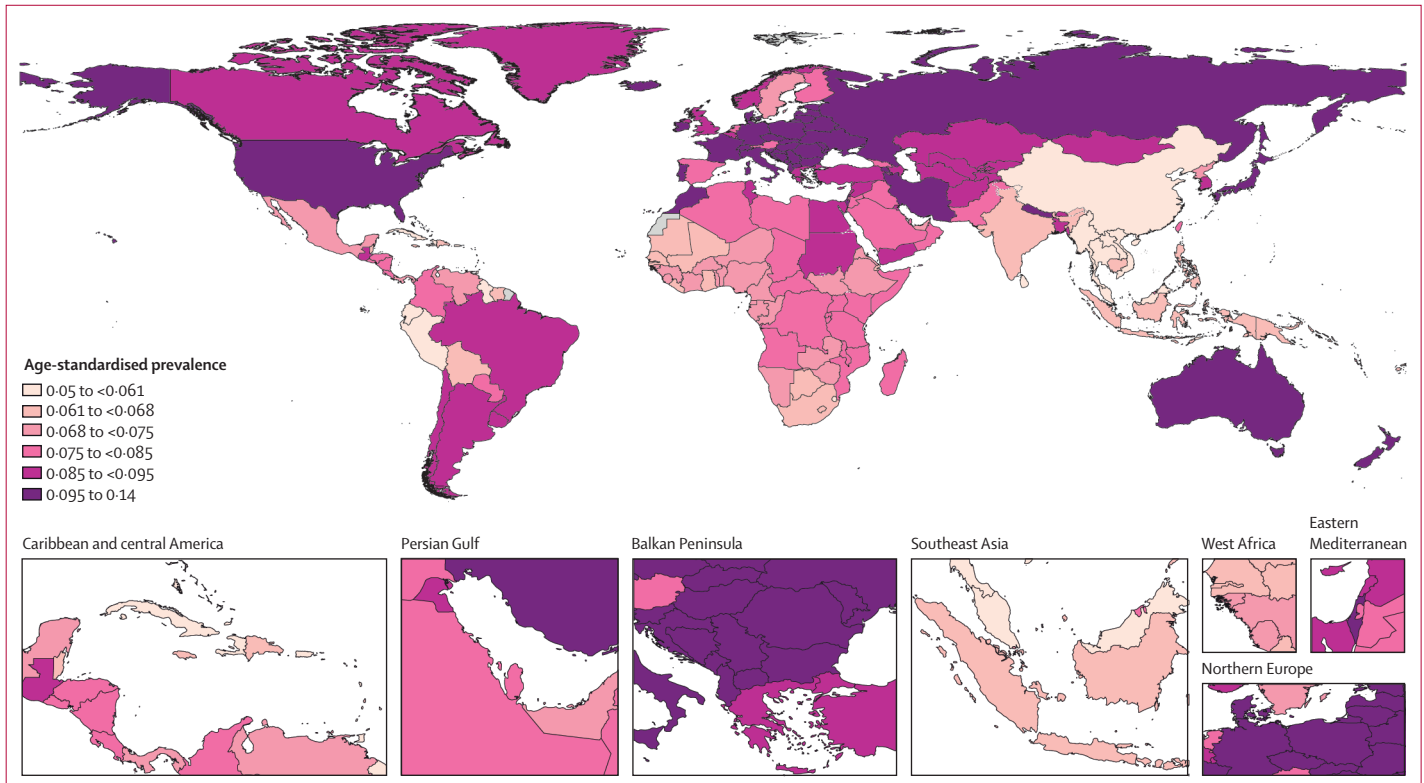


Figure 1: Age-standardised prevalence of low back pain by country for male and female sexes combined and all ages in 2020

age-standardised rate of prevalence per 100 000 was also higher in females (9330; 95% UI 8370–10 500) compared with males (5520; 4930–6190). Prevalence and YLDs increased with age, with peak prevalence rates observed at approximately 85 years of age (figure 2). Globally, the age group 80–84 years had the highest YLD rate per 100 000 (2440; 1470–3490).

Prevalence and YLD counts and age-standardised rates per 100 000 population in 2020, and corresponding percentage changes between 1990 and 2020, for male and female sexes combined, by GBD super-regions (central

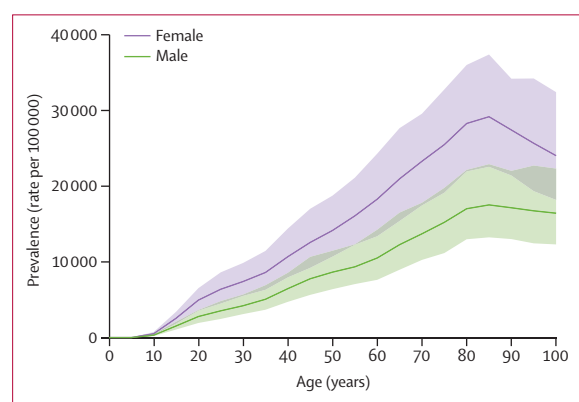


Figure 2: Global prevalence of low back pain by age and sex in 2020. Shaded areas represent 95% uncertainty intervals.

Europe, eastern Europe, and central Asia; high-income; Latin America and Caribbean; north Africa and Middle East; south Asia; southeast Asia, east Asia, and Oceania; and sub-Saharan Africa), are presented in table 1. The highest age-standardised rate of low back pain prevalence per 100 000 was observed in the central Europe, eastern Europe, and central Asia super-region (11 200; 95% UI 10 100 to 12 600), with the lowest age-standardised rate of prevalence per 100 000 observed in the southeast Asia, east Asia, and Oceania super-region (5560; 4970 to 6260). Similarly, the highest age-standardised rate of YLDs per 100 000 was observed in the central Europe, eastern Europe, and central Asia super-region (1250; 873 to 1620), whereas the lowest age-standardised rate was observed in the southeast Asia, east Asia, and Oceania super-region (627; 433 to 809; table 1). A small decrease in the age-standardised rates of prevalence between 1990 and 2020 was observed for all super-regions, except for the Latin America and Caribbean super-region, which had a small percentage increase of 1.9% (1.3 to 2.8). Countries of the southeast Asia, east Asia, and Oceania super-region presented the largest decrease (–14.5%; –15.4 to –13.4). A similar pattern was seen for YLDs (table 1).

In 2020, 38.8% (95% UI 28.7–47.0) of global YLDs due to low back pain were attributable to exposure to three modifiable GBD risk factors. Globally, and across all ages and male and female sexes combined, 22.0%

	Age-standardised prevalence (%)			Cases (millions)		
	2030	2040	2050	2030	2040	2050
Global	7.30% (6.52–8.21)	7.17% (6.38–8.08)	7.08% (6.28–7.99)	707 (638–788)	785 (710–872)	843 (759–933)
Andean Latin America	5.68% (5.10–6.38)	5.60% (5.02–6.30)	5.53% (4.96–6.24)	4.37 (3.90–4.89)	5.11 (4.50–5.73)	5.74 (4.99–6.52)
Australasia	11.0% (9.65–12.5)	10.9% (9.58–12.4)	10.9% (9.50–12.4)	4.61 (4.11–5.16)	5.09 (4.51–5.70)	5.49 (4.83–6.21)
Caribbean	5.86% (5.20–6.52)	5.76% (5.10–6.41)	5.66% (4.99–6.32)	3.38 (3.04–3.71)	3.65 (3.29–4.00)	3.80 (3.39–4.23)
Central Asia	9.05% (8.01–10.1)	8.96% (7.92–10.1)	8.88% (7.84–9.98)	9.45 (8.40–10.6)	10.6 (9.45–11.9)	11.6 (10.3–13.0)
Central Europe	12.7% (11.4–14.3)	12.6% (11.3–14.2)	12.5% (11.2–14.2)	20.0 (17.9–22.3)	19.2 (17.4–21.3)	18.0 (16.3–20.0)
Central Latin America	7.38% (6.54–8.34)	7.27% (6.43–8.23)	7.17% (6.36–8.13)	22.4 (20.0–25.1)	24.9 (22.2–27.9)	26.5 (23.5–29.9)
Central sub-Saharan Africa	7.31% (6.51–8.23)	7.16% (6.36–8.08)	7.04% (6.24–7.96)	8.84 (7.80–9.82)	11.7 (10.2–12.9)	14.9 (13.0–16.7)
East Asia	5.33% (4.77–6.01)	5.25% (4.68–5.93)	5.16% (4.58–5.84)	116 (104–129)	120 (108–135)	116 (104–129)
Eastern Europe	11.1% (9.95–12.4)	11.0% (9.83–12.3)	10.9% (9.74–12.3)	32.4 (28.9–36.2)	32.1 (28.6–36.0)	31.3 (27.8–35.2)
Eastern sub-Saharan Africa	7.44% (6.63–8.29)	7.30% (6.48–8.14)	7.18% (6.36–8.02)	27.7 (24.6–30.7)	37.1 (32.9–41.4)	48.2 (42.2–54.3)
High-income Asia Pacific	9.57% (8.45–10.8)	9.46% (8.34–10.7)	9.38% (8.27–10.6)	26.6 (23.8–29.4)	25.7 (23.0–28.4)	24.0 (21.6–26.6)
High-income North America	10.4% (9.83–11.1)	10.4% (9.76–11.0)	10.3% (9.68–11.0)	53.2 (49.7–56.3)	55.8 (52.5–59.7)	57.0 (53.4–61.4)
North Africa and Middle East	8.55% (7.59–9.60)	8.38% (7.41–9.43)	8.25% (7.28–9.29)	61.6 (54.7–69.4)	72.4 (64.7–81.0)	81.8 (72.7–91.9)
Oceania	6.25% (5.46–7.04)	6.12% (5.33–6.91)	5.98% (5.19–6.76)	0.848 (0.734–0.954)	1.08 (0.934–1.21)	1.34 (1.14–1.53)
South Asia	6.82% (6.04–7.78)	6.70% (5.91–7.66)	6.61% (5.80–7.57)	138 (123–156)	159 (143–175)	176 (158–191)
Southeast Asia	5.78% (5.13–6.53)	5.68% (5.04–6.43)	5.59% (4.96–6.34)	49.1 (44.1–55.1)	56.6 (51.1–62.7)	61.9 (55.5–68.4)
Southern Latin America	9.21% (8.17–10.4)	9.13% (8.10–10.3)	9.06% (8.03–10.2)	7.80 (6.98–8.71)	8.34 (7.49–9.29)	8.63 (7.72–9.58)
Southern sub-Saharan Africa	6.45% (5.73–7.26)	6.40% (5.67–7.21)	6.35% (5.62–7.20)	5.48 (4.90–6.11)	6.50 (5.83–7.27)	7.49 (6.71–8.42)
Tropical Latin America	9.07% (8.01–10.2)	8.96% (7.89–10.1)	8.87% (7.79–10.0)	25.5 (22.6–28.5)	27.3 (24.4–30.5)	28.2 (25.3–31.3)
Western Europe	9.44% (8.41–10.6)	9.39% (8.34–10.6)	9.34% (8.28–10.5)	60.4 (53.3–66.8)	61.7 (54.8–68.2)	61.4 (54.4–67.7)
Western sub-Saharan Africa	6.73% (5.97–7.55)	6.59% (5.80–7.39)	6.45% (5.64–7.25)	28.6 (25.2–32.0)	38.3 (33.6–42.9)	50.1 (44.1–56.9)

Data in parentheses are 95% uncertainty intervals. Region numbers do not sum to the global prevalence due to rounding.

Table 2: Age-standardised prevalence and cases of low back pain projections to 2030, 2040, and 2050, globally and by region, male and female sexes combined

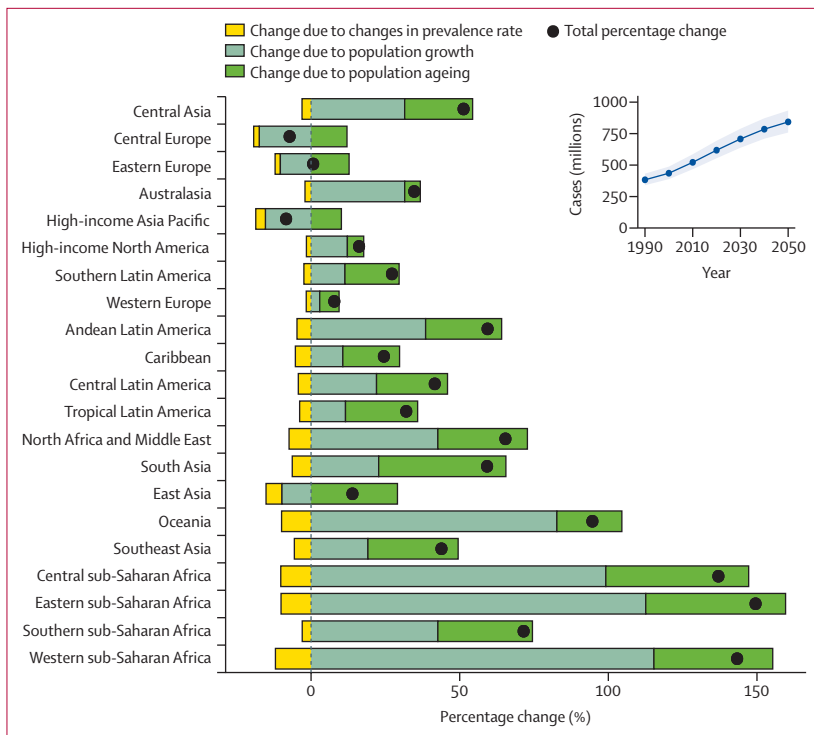


Figure 3: Decomposition of projected change in the number of prevalent low back pain cases between 2020 and 2050

(20.4–23.4) of YLDs were attributable to occupational ergonomic factors, 12.5% (3.1–21.5) to smoking, and 11.5% (1.4–20.9) to high BMI. These represent a total of 194 YLDs (137–261) per 100 000 population attributed to occupational risks; 110 (29–192) to smoking, and 102 (11–195) to high BMI. The risk of low back pain attributed to smoking was highest among middle-aged (ie, 50–69 years of age) males (28.8%; 7.5–48.9) and lowest among females aged 15–49 years (5.7%; 1.3–10.3), whereas the risk attributed to occupational ergonomic factors was highest among younger (ie, 15–49 years of age) male adults (34.3%; 31.9–36.6) and lowest among females 70 years of age or older (4.9%; 3.8–6.0). The risk of low back pain attributed to high BMI was, however, highest among females aged 50–69 years (14.5%; 1.8–26.2) and lowest among younger (ie, 15–49 years) males (9.8%; 1.2–17.5).

Based on forecasted changes in population, in 2050 there will be 843 million (95% UI 759–933) individuals worldwide with low back pain (table 2) or an increase in total cases of 36.4% (29.9–43.2) globally (figure 3). The projected increase in number of cases globally was similar among males and females (appendix p 30). While most regions had a greater than 25% projected increase in cases between 2020 and 2050, central Europe, eastern Europe, and high-income Asia Pacific had a total projected decrease in cases over that period (table 2). A decomposition analysis by region and globally showed the greatest contribution of population growth, followed

by population ageing, to the projected increase in number of cases by 2050 (figure 3). This was true for all regions except for east Asia, south Asia, tropical Latin America, southern Latin America, and the Caribbean; in these regions, the greatest contribution to the projected increase in number of cases appeared to come from population ageing.

### Discussion

This report presents estimates of low back pain prevalence and burden at global, regional, and national levels. In 2020, there were more than half a billion prevalent cases of low back pain worldwide, representing 7.7% of all YLDs and thus the greatest contribution to the world's burden of disability. By 2050, a 36.4% increase in total number of cases of low back pain is expected globally, with the most substantial increases expected to be seen in Asia and Africa. Decomposition analyses show that most of the increase in prevalence will be driven by population growth, except in some regions where population ageing seems to be the main reason for the rise in the number of low back pain cases by 2050.

The high rate of low back pain prevalence observed in all regions globally could have some important social and economic consequences, especially considering the substantial cost of care for this condition. For instance, from 2012 to 2014, the direct aggregate costs for all individuals with a spine condition in the USA were US\$315 billion,<sup>15</sup> with a substantial proportion of costs attributed to surgical procedures. Moreover, prescription medications for spine conditions in Australia showed a marked rise in the past years, with opioids becoming the most commonly prescribed class of drugs for low back pain.<sup>16</sup> Opioids are now well recognised to be responsible for important adverse health events, including high rates of addiction, accidental overdose, and death,<sup>17</sup> resulting in additional costs to the individual and society due to medical care for opioid abuse and loss of productivity.<sup>18</sup> While somewhat speculative, it is possible that improving access to effective non-pharmacological care for low back pain might reduce some of the impact of the opioid epidemic.

A further societal and economic impact of low back pain stems from its high prevalence and substantial burden in working-age people—a problem certainly not exclusive to high-income countries. An average of 100 days absent from work per person per year were due to low back pain in Brazil, with productivity losses equating to 79% of the US\$2.2 billion cost of low back pain.<sup>19</sup> In the USA, 15.4% of the workforce report an average of 10.5 lost workdays per year due to chronic low back pain. This is equivalent to approximately 264 million workdays lost.<sup>20</sup> On top of absenteeism from work, low back pain might force workers to retire prematurely.<sup>21</sup> People who retire early because of low back pain have substantially less total wealth and income-producing assets than those who remain in full-time employment.<sup>22</sup>



Therefore, more emphasis should be given to integrated and early return to work interventions. As suggested in the literature, these interventions should include those based around cognitive behavioural therapy principles, problem-solving skills, and ergonomics, with involvement at the supervisor level. These interventions should lead to fewer disability days, higher rates of and earlier return to work, and reductions in use of health care.<sup>6,23,24</sup> Moreover, initiatives that focus on work environments involving manual labour, and those in low-income and middle-income countries, are urgently needed.

We have seen a modest decrease from 1990 in the age-standardised rate of prevalence and YLDs of low back pain. While our data cannot be used to ascertain the reason for the decrease, it is possible that it represents a shift in the incidence of low back pain perhaps due to changes in manual labour or increased recovery. It is important to remember, however, that low back pain remains the main contributor to disability worldwide, and global strategies to reduce the number of new episodes of low back pain and its associated disability are key. Nevertheless, there is scarce evidence supporting prevention strategies for low back pain, especially in specific populations such as older patients, or those targeting low-income and middle-income countries. Focused solutions include public health prevention strategies, particularly those that are affordable in and relevant to low-income and middle-income countries, and will first need widespread testing and implementation.

Challenges in addressing the burden of low back pain in both high-income countries and low-income and middle-income countries are different. Aligning health care to adhere to clinical guidelines to reduce excessive opioid use and unnecessary and costly surgical treatments is imperative. As treatment effectiveness data come nearly exclusively from high-income countries, the cultural suitability of guideline recommendations for low-income and middle-income countries is not known. The treatment of low back pain in high-income countries is likely to be influenced by access to health care, governing payment models that include health insurance, and health promotion campaigns.

Our results show that the prevalence of low back pain increases with age, with a peak rate observed at approximately 85 years of age. It is known from previous research that, compared with younger adults, older adults are more likely to be severely incapacitated by low back pain, with loss of mobility and independence, leading to greater care needs.<sup>25</sup> In fact, one-fifth of older adults with low back pain report difficulties in caring for themselves at home or participating in family and social activities.<sup>26</sup> Older people are also more likely to report poorer outcomes and slower recovery<sup>27</sup> when compared with younger adults. As the population ages, the inclusion of targeted and specific management recommendations for the older population, which take

into consideration age-relevant clinical outcomes (ie, institutionalisation, falls, mobility), preferences, and acceptability is essential in decreasing the burden of low back pain globally. An important and global initiative, the WHO Integrated Care for Older People (ICOPE) approach, grounded on the healthy ageing model, highlights the need to increase intrinsic musculoskeletal health capacity in older people, offering guidance for the assessment and management of the older patient in primary care.<sup>28</sup>

Estimates show that among those available in the GBD study, three modifiable factors play an important role in the global burden of low back pain. Nearly one-quarter of YLDs due to low back pain were attributed to occupational ergonomic factors, which can include prolonged sitting or standing, bending, or lifting. As previously discussed, low back pain forces more people out of the workplace than any other chronic health condition.<sup>21</sup> Work exposures to lifting, bending, awkward postures, vibration, and tasks considered physically demanding are associated with an increased risk of developing low back pain; however, independent causal relationships have not been demonstrated.<sup>29,30</sup> Globally, 12.5% and 11.5% of YLDs due to low back pain were attributed to the lifestyle factors smoking and elevated BMI, respectively. Although both smoking<sup>31</sup> and obesity<sup>32</sup> have been shown to be associated with the occurrence of low back pain and the development of persistent low back pain, the specific causal mechanisms for these associations remain uncertain. Likewise, we lack evidence on the effectiveness of preventive strategies targeting these two risk factors.

Strengths of this systematic analysis include adjustment of data to increase comparability between disparate sources, and capability of DisMod-MR 2.1 to leverage information from data-rich locations to inform estimates where no data are available. The current analyses also include, for the first time, prevalence projections to 2050 and the relative contribution of GBD risk factors to the burden of low back pain.

Limitations include the heterogeneous nature of input data, which reported low back pain based on a wide range of case definitions and recall periods. Although regression methods produce adjustments to make data sources with disparate case definitions more comparable, these methods additionally introduce uncertainty and rely on generalisation from a limited number of studies that provide data on different case definitions. This issue was compounded by relatively few predictive covariates in our models, as the relationship between low back pain prevalence and other potential risk factors is not well quantified. Lastly, our projections have not accounted for the impact of COVID-19 on the prevalence and burden of low back pain, including worsened occupational ergonomic factors, decreased access to treatment, or higher mortality in older adults.

Challenges persist in obtaining primary country-level data on low back pain prevalence, especially in

low-income countries. This is mainly due to data sparsity, difficulties in collecting representative samples, and countries having restricted data-sharing policies. Data sparsity can increase the influence of granular high-income data (such as US claims data), which can unduly impact global age and time patterns. This lack of primary data limits the ability to draw strong inference from any regional and country-level variations. The Surveillance Task Force of the Global Alliance for Musculoskeletal Health has identified collections of national musculoskeletal burden data from low-income and middle-income countries as a priority and have developed and field-tested a musculoskeletal survey questionnaire.<sup>33</sup> While our estimates benefited from the inclusion of multi-country surveys such as the World Health and COPCORD surveys, the collection of additional and standardised primary data in these regions remains a high priority. Finally, we acknowledge that our estimates for many countries are based on modelled rather than observed data.<sup>34</sup> Although we recognise it would be ideal to have primary-level data from every country, and using standardised methodology, this is unlikely to be achieved. By using statistical adjustments for key covariates and harmonisation of between-study heterogeneity by formally using a reference definition, our modelled data provide the most accurate estimates of global prevalence and burden of low back pain.

In conclusion, in 2020, there were more than half a billion prevalent cases of low back pain worldwide, and by 2050 this is projected to increase to more than 800 million prevalent cases. Age-standardised rates have decreased slightly over the past three decades, but case numbers continue to rise because of population growth and ageing, particularly in Asia and Africa. Low back pain remains the leading cause of years lived with disability globally. Prevalence and years lived with disability due to low back pain increase with age, peaking at 85 years, and compromise the prospect of healthy ageing. Our results highlight the urgent need for more and high-quality primary country-level data on both prevalence and severity distributions to improve accuracy and monitor change as health policy and high-value care are implemented.

#### GBD 2021 Low Back Pain Collaborators

Manuela L Ferreira, Katie de Luca, Lydia M Haile, Jaimie D Steinmetz, Garland T Culbreth, Marita Cross, Jacek A Kopec, Paulo H Ferreira, Fiona M Blyth, Rachele Buchbinder, Jan Hartvigsen, Ai-Min Wu, Saeid Safiri, Anthony D Woolf, Gary S Collins, Kanyin Liane Ong, Stein Emil Vollset, Amanda E Smith, Jessica A Cruz, Kai Glenn Fukutaki, Semagn Mekonnen Abate, Mitra Abbasifard, Mohsen Abbasi-Kangevari, Zeinab Abbasi-Kangevari, Ahmed Abdelalim, Aidin Abedi, Hassan Abidi, Qorinah Estiningtyas Sakilah Adnani, Ali Ahmadi, Rufus Olusola Akinyemi, Abayneh Tadesse Alamer, Adugnaw Zeleke Alem, Yousef Alimohamadi, Mansour Abdullah Alshehri, Mohammed Mansour Alshehri, Hosam Alzahrani, Saeed Amini, Sohrab Amiri, Hubert Amu, Catalina Liliana Andrei, Tudorel Andrei, Benny Antony, Jalal Arabloo, Judie Arulappan, Ashokan Arumugam, Tahira Ashraf, Seyyed Shamsadin Athari, Nefsu Awoke, Sina Azadnajafabad, Till Winfried Bärnighausen, Lope H Barrero, Amadou Barrow,

Akbar Barzegar, Lindsay M Bearne, Isabela M Bensenor, Alemshet Yirga Berhie, Bharti Bhandari Bhandari, Vijayalakshmi S Bhojaraja, Ali Bijani, Belay Boda Abule Bodicha, Srinivasa Rao Bolla, Javier Brazo-Sayavera, Andrew M Briggs, Chao Cao, Periklis Charalampous, Vijay Kumar Chattu, Flavia M Cicuttini, Benjamin Clarsen, Sarah Cuschieri, Omid Dadras, Xiaochen Dai, Lalit Dandona, Rakhi Dandona, Azizallah Dehghan, Takele Gezahegn G Demie, Edgar Denova-Gutiérrez, Syed Masudur Rahman Dewan, Samath Dhamminda Dharmaratne, Mandira Lamichhane Dhimal, Meghnath Dhimal, Daniel Diaz, Mojtaba Didehdar, Lankamo Ena Digesa, Mengistie Diress, Hoa Thi Do, Linh Phuong Doan, Michael Ekholuentele, Muhammed Elhadi, Sharareh Eskandarieh, Shahriar Faghani, Jawad Fares, Ali Fatehizadeh, Getahun Fetensa, Irina Filip, Florian Fischer, Richard Charles Franklin, Balasankar Ganesan, Belete Negese Belete Gemed, Motuma Erena Getachew, Ahmad Ghashghaee, Tiffany K Gill, Mahaveer Golechha, Pouya Goleij, Bhawna Gupta, Nima Hafezi-Nejad, Arvin Haj-Mirzaian, Pawan Kumar Hamal, Asif Hanif, Netanja I Harlianto, Hamidreza Hasani, Simon I Hay, Jeffrey J Hebert, Golnaz Heidari, Mohammad Heidari, Reza Heidari-Soureshjani, Mbuzeleni Mbuzeleni Hlongwa, Mohammad-Salar Hosseini, Alexander Kevin Hsiao, Ivo Iavicoli, Segun Emmanuel Ibitoye, Irena M Ilic, Milena D Ilic, Sheikh Mohammed Shariful Islam, Manthan Dilipkumar Janodia, Ravi Prakash Jha, Har Ashish Jindal, Jost B Jonas, Gebisa Guyasa Kabito, Himal Kandel, Rimple Jeet Kaur, Vikash Ranjan Keshri, Yousef Saleh Khader, Ejaz Ahmad Khan, Md Jobair Khan, Moien AB Khan, Hamid Reza Khayat Kashani, Jagdish Khubchandani, Yun Jin Kim, Adnan Kisa, Jitka Klugarová, Ali-Asghar Kolahi, Hamid Reza Koohestani, Ai Koyanagi, G Anil Kumar, Narinder Kumar, Tea Lallukka, Savita Lasrado, Wei-Chen Lee, Yo Han Lee, Ata Mahmoodpoor, Jeadran N Malagón-Rojas, Mohammad-Reza Malekpour, Reza Malekzadeh, Narges Malih, Man Mohan Mehndiratta, Entezar Mehrabi Nasab, Ritesh G Menezes, Alexios-Fotios A Mentis, Mohamed Kamal Mesregah, Ted R Miller, Mohammad Mirza-Aghazadeh-Attari, Maryam Mobarakabadi, Yousef Mohammad, Esmail Mohammadi, Shafiu Mohammed, Ali H Mokdad, Sara Momtazmanesh, Lorenzo Monasta, Mohammad Ali Moni, Ebrahim Mostafavi, Christopher J L Murray, Tapas Sadasivan Nair, Javad Nazari, Seyed Aria Nejadghaderi, Subas Neupane, Sandhya Neupane Kandel, Cuong Tat Nguyen, Ali Nowroozi, Hassan Okati-Aliabad, Emad Omer, Abderrahim Oulhaj, Mayowa O Owolabi, Songhomitra Panda-Jonas, Anamika Pandey, Eun-Kee Park, Shrikant Pawar, Paolo Pedersini, Jeevan Pereira, Mario F P Peres, Ionela-Roxana Petcu, Mohammadreza Pourahmadi, Amir Radfar, Shahram Rahimi-Dehgolan, Vafa Rahimi-Movaghar, Mosiur Rahman, Amir Masoud Rahmani, Nazanin Rajai, Chythra R Rao, Vahid Rashedi, Mohammad-Mahdi Rashidi, Zubair Ahmed Ratan, David Laith Rawaf, Salman Rawaf, Andre M N Renzaho, Negar Rezaei, Zاهد Rezaei, Leonardo Roever, Guilherme de Andrade Ruela, Basema Saddik, Amirhossein Sahebkar, Sana Salehi, Francesco Sanmarchi, Sadaf G Sepanlou, Saeed Shahabi, Shayan Shahrokhi, Elaheh Shaker, MohammadBagher Shamsi, Mohammed Shannawaz, Saurab Sharma, Maryam Shaygan, Rahim Ali Sheikh, Jeevan K Shetty, Rahman Shiri, Siddharudha Shivalli, Parnian Shobeiri, Migbar Mekonnen Sibhat, Ambrish Singh, Jasvinder A Singh, Helen Slater, Marco Solmi, Ranjani Somayaji, Ker-Kan Tan, Rekha Thapar, Seyed Abolfazl Tohidast, Sahel Valadan Tahbaz, Rohollah Valizadeh, Tommi Juhani Vasankari, Narayanaswamy Venketasubramanian, Vasily Vlassov, Bay Vo, Yuan-Pang Wang, Taweewat Wiangkham, Lalit Yadav, Ali Yadollahpour, Seyed Hossein Yahyazadeh Jabbari, Lin Yang, Fereshteh Yazdanpanah, Naohiro Yonemoto, Mustafa Z Younis, Iman Zare, Armin Zarrintan, Mohammad Zoladl, Theo Vos\*, Lyn M March\*.

\*Jointly supervised the work

#### Affiliations

Sydney Musculoskeletal Health (Prof M L Ferreira PhD, L M March PhD, M Cross PhD, Prof P H Ferreira PhD, Prof F M Blyth PhD), Sydney Medical School (S Islam PhD), Save Sight Institute (H Kandel PhD), Faculty of Medicine and Health, University of Sydney, Sydney, NSW, Australia; Discipline of Chiropractic (K de Luca PhD), CQ University, Brisbane, QLD, Australia; Institute for

For the musculoskeletal survey questionnaire see <https://gmusc.com/msk-survey-module/>

Health Metrics and Evaluation (L M Haile MPH, J D Steinmetz PhD, G T Culbreth PhD, K L Ong PhD, Prof S Vollset DrPH, A E Smith MPA, J A Cruz BSc, X Dai PhD, Prof L Dandona MD, Prof R Dandona PhD, Prof S D Dharmaratne MD, Prof S I Hay FMedSci, A H Mokdad PhD, Prof C J L Murray DPhil, Prof T Vos PhD), Department of Health Metrics Sciences, School of Medicine (Prof S Vollset DrPH, X Dai PhD, Prof R Dandona PhD, Prof S D Dharmaratne MD, Prof S I Hay FMedSci, A H Mokdad PhD, Prof C J L Murray DPhil, Prof T Vos PhD), Department of Medicine (R Somayaji MD), University of Washington, Seattle, WA, USA; School of Population and Public Health (J A Kopec PhD), University of British Columbia, Vancouver, BC, Canada; Arthritis Research Canada, Richmond, BC, Canada (J A Kopec PhD); Department of Epidemiology and Preventive Medicine (Prof R Buchbinder PhD), School of Public Health and Preventive Medicine (Prof F M Cicuttini PhD), Monash University, Melbourne, VIC, Australia; Monash Department of Clinical Epidemiology at Cabrini Hospital (Prof R Buchbinder PhD), Cabrini Institute, Melbourne, VIC, Australia; Department of Sports Science and Clinical Biomechanics (Prof J Hartvigsen PhD), University of Southern Denmark, Odense, Denmark; Research Department (Prof J Hartvigsen PhD), Nordic Institute of Chiropractic and Clinical Biomechanics, Odense, Denmark; Department of Orthopaedics (Prof A Wu MD), Wenzhou Medical University, Wenzhou, China; Aging Research Institute (S Safiri PhD), Department of Community Medicine (S Safiri PhD), Student Research Committee (M Hosseini MD), Anesthesiology and Critical Care (Prof A Mahmoodpoor MD), Department of Radiology (M Mirza-Aghazadeh-Attari MD, A Zarrintan MD), Department of Pediatric Allergy and Immunology (F Yazdanpanah MD), Tabriz University of Medical Sciences, Tabriz, Iran; Bone and Joint Research Group (Prof A D Woolf MBBS), Royal Cornwall Hospital, Truro, UK; Nuffield Department of Orthopaedics, Rheumatology, and Musculoskeletal Sciences (Prof G S Collins PhD), University of Oxford, Oxford, UK; Public Health (K G Fukutaki MPH), Independent Consultant, Seattle, WA, USA; Anesthesiology Department (S M Abate MSc), Dilla University, Addis Ababa, Ethiopia; Department of Internal Medicine (M Abbasifard MD), Clinical Research Development Unit (M Abbasifard MD), Rafsanjan University of Medical Sciences, Rafsanjan, Iran; Non-communicable Diseases Research Center (M Abbasi-Kangevari MD, Z Abbasi-Kangevari BSc, S Azadnajafabad MD, M Malekpoor MD, S Momtazmanesh MD, M Rashidi MD, N Rezaei PhD), Multiple Sclerosis Research Center (S Eskandarieh PhD), Interdisciplinary Neuroscience Research Program (S Faghani MD), Faculty of Medicine (N Hafezi-Nejad MD, E Mohammadi MD, E Shaker MD, P Shobeiri MD), Digestive Diseases Research Institute (Prof V Rahimi-Movaghar MD, S G Sepanlou MD), Tehran Heart Center (E Mehrabi Nasab MD), School of Medicine (S Momtazmanesh MD, A Nowroozi BMedSc), Physical Medicine and Rehabilitation (S Rahimi-Dehghan MD), Sina Trauma and Surgery Research Center (Prof V Rahimi-Movaghar MD), Endocrinology and Metabolism Research Institute (N Rezaei PhD), Department of Psychiatry (S Shahrokhi MD), Department of Pediatric Allergy and Immunology (F Yazdanpanah MD), Tehran University of Medical Sciences, Tehran, Iran (R Heidari-Soureshjani MSc, E Mohammadi MD); Social Determinants of Health Research Center (Z Abbasi-Kangevari BSc, A Kolahi MD, M Rashidi MD), Department of Epidemiology (A Ahmadi PhD), Department of Pharmacology (A Haj-Mirzaian MD), Obesity Research Center (A Haj-Mirzaian MD), Department of Neurosurgery (H Khayat Kashani MD), School of Medicine (S Nejadghaderi MD), Shahid Beheshti University of Medical Sciences, Tehran, Iran; Department of Neurology (Prof A Abdelalim MD), Cairo University, Cairo, Egypt; Department of Neurosurgery (A Abedi MD), Keck School of Medicine (A Abedi MD), Mark and Mary Stevens Neuroimaging and Informatics Institute (S Salehi MD), University of Southern California, Los Angeles, CA, USA; Laboratory Technology Sciences Department (H Abidi PhD), Department of Nursing (M Zoladi PhD), Yasuj University of Medical Sciences, Yasuj, Iran; Faculty of Medicine (Q E S Adnani PhD), Universitas Padjadjaran (Padjadjaran University), Bandung, Indonesia; Department of Epidemiology and Biostatistics (A Ahmadi PhD), Community-Oriented Nursing Midwifery Research Center (M Heidari PhD), Department of Health in Disasters and Emergencies

(R Sheikh BHLthSci), Shahrekord University of Medical Sciences, Shahrekord, Iran; Institute for Advanced Medical Research and Training (R O Akinyemi PhD), Department of Epidemiology and Medical Statistics (M Ekholuenetale MSc), Faculty of Public Health (M Ekholuenetale MSc), Department of Health Promotion and Education (S E Ibitoye MPH), Department of Medicine (Prof M O Owolabi DrM), University of Ibadan, Ibadan, Nigeria; Institute of Neuroscience (R O Akinyemi PhD), Newcastle University, Newcastle upon Tyne, UK; Department of Physiotherapy (A T Alamer MSc), Mekelle University, Mekelle, Ethiopia; Department of Epidemiology and Biostatistics (A Z Alem MPH), Department of Human Physiology (M Diress MSc), Environmental and Occupational Health and Safety Department (G G Kabito MPH), University of Gondar, Gondar, Ethiopia; Health Research Center (Y Alimohamadi PhD), Quran and Hadith Research Center (S Amiri PhD), Baqiyatallah University of Medical Sciences, Tehran, Iran; Physiotherapy Department (M A Alshehri PhD), Umm Al-Qura University, Mecca, Saudi Arabia; Pharmaceutical Care (M Alshehri PharmD), Ministry of National Guard-Health Affairs, Riyadh, Saudi Arabia; Taif University, Taif, Saudi Arabia (H Alzahrani PhD); Department of Health Services Management (S Amini PhD), Khomein University of Medical Sciences, Khomein, Iran; Department of Population and Behavioural Sciences (H Amu PhD), University of Health and Allied Sciences, Ho, Ghana; Cardiology Department (C Andrei PhD), Carol Davila University of Medicine and Pharmacy, Bucharest, Romania; Department of Statistics and Econometrics (Prof T Andrei PhD, I Petcu PhD), Bucharest University of Economic Studies, Bucharest, Romania; Menzies Institute for Medical Research (B Antony PhD, A Singh Mtech), University of Tasmania, Hobart, TAS, Australia; Health Management and Economics Research Center (J Arabloo PhD), Department of Physiotherapy (M Pourahmadi PhD), Iran University of Medical Sciences, Tehran, Iran; Department of Maternal and Child Health (J Arulappan DSc), Sultan Qaboos University, Muscat, Oman; Department of Physiotherapy (A Arumugam PhD), Sharjah Institute for Medical Research (B Saddik PhD), University of Sharjah, Sharjah, United Arab Emirates; Community Medicine and Rehabilitation - Physiotherapy Section (A Arumugam PhD), Umeå University, Umeå, Sweden; University Institute of Radiological Sciences and Medical Imaging Technology (T Ashraf MS), University Institute of Public Health (A Hanif PhD), The University of Lahore, Lahore, Pakistan; Department of Immunology (S Athari PhD), Zanjani University of Medical Sciences, Zanjan, Iran; Department of Nursing (N Awoke MSc), Wolaita Sodo University, Wolaita Sodo, Ethiopia; Heidelberg Institute of Global Health (HIGH) (Prof T W Bärnighausen MD), Heidelberg University, Heidelberg, Germany; TH Chan School of Public Health (Prof T W Bärnighausen MD), Department of Internal Medicine (N Rajai MD), Harvard University, Boston, MA, USA; Department of Industrial Engineering (Prof L H Barrero DSc), Pontifical Javeriana University, Bogota, Colombia; Department of Public & Environmental Health (A Barrow MPH), University of The Gambia, Brikama, The Gambia; Epidemiology and Disease Control Unit (A Barrow MPH), Ministry of Health, Kotu, The Gambia; Department of Occupational Health Engineering (A Barzegar PhD), School of Public Health (Z Rezaei PhD), Department of Sports Medicine and Rehabilitation (M Shamsi PhD), Kermanshah University of Medical Sciences, Kermanshah, Iran; Population Health Research Institute (Prof L M Bearn PhD), University of London, London, UK; Centre for Engagement and Dissemination (Prof L M Bearn PhD), National Institute for Health Research, Twickenham, UK; Department of Internal Medicine (I M Bensenor PhD), Department of Psychiatry (Prof M F P Peres MD, Y Wang PhD), University of São Paulo, São Paulo, Brazil; School of Health Science (A Y Berhie MSc), Bahir Dar University, Bahir Dar, Ethiopia; Physiology Department (B B Bhandari MD), Government Institute of Medical Sciences, Greater Noida, India; Department of Anatomy (V S Bhojaraja MD), Department of Biochemistry (J K Shetty MD), Royal College of Surgeons in Ireland Medical University of Bahrain, Busaiteen, Bahrain; Social Determinants of Health Research Center (A Bijani PhD), Babol University of Medical Sciences, Babol, Iran; Biomedical Sciences Department (B B A Bodicha MSc), Department of Comprehensive Nursing (L E Digesa MSc), Arba Minch University, Arba Minch, Ethiopia;

Department of Biomedical Sciences (S Bolla PhD), Nazarbayev University, Nur-Sultan City, Kazakhstan; Centro Regional Universitario Noreste (J Brazo-Sayavera PhD), University of the Republic of Uruguay, Rivera, Uruguay; School of Physiotherapy and Exercise Science (Prof A M Briggs PhD, Prof H Slater PhD), School of Public Health (T R Miller PhD), Curtin University, Perth, WA, Australia; Program in Physical Therapy (C Cao MPH), Washington University in St Louis, St Louis, MO, USA; Department of Public Health (P Charalampous MSc), Erasmus University Medical Center, Rotterdam, Netherlands; Department of Community Medicine (V Chattu MD), Datta Meghe Institute of Medical Sciences, Sawangi, India; Saveetha Medical College and Hospitals (V Chattu MD), Saveetha University, Chennai, India; Department of Disease Burden (B Clarsen PhD), Norwegian Institute of Public Health, Bergen, Norway; Department of Sports Medicine (B Clarsen PhD), Norwegian School of Sport Sciences, Oslo, Norway; Anatomy Department (S Cuschieri PhD), University of Malta, Msida, Malta; Section Global Health and Rehabilitation (O Dadras DrPH), Western Norway University of Applied Sciences, Bergen, Norway; Department of Global Public Health and Primary Care (O Dadras DrPH), University of Bergen, Bergen, Norway; Department of Research (A Pandey PhD), Public Health Foundation of India, Gurugram, India (Prof L Dandona MD, Prof R Dandona PhD, G Kumar PhD); Indian Council of Medical Research, New Delhi, India (Prof L Dandona MD); Department of Epidemiology and Community Medicine (A Dehghan PhD), Non-Communicable Diseases Research Center (NCDRC), Fasa, Iran; Public Health Department (T G Demie MPH), St Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia; Emergency Operating Center (EOC) (T G Demie MPH), Ethiopian Public Health Institute, Addis Ababa, Ethiopia; Center for Nutrition and Health Research (E Denova-Gutiérrez DSc), National Institute of Public Health, Cuernavaca, Mexico; Department of Pharmacy (S Dewan PhD), University of Asia Pacific, Dhaka, Bangladesh; Pharmacology Department (S Dewan PhD), Center for Life Sciences Research Bangladesh, Dhaka, Bangladesh; Department of Community Medicine (Prof S D Dharmaratne MD), University of Peradeniya, Peradeniya, Sri Lanka; Policy Research Institute, Kathmandu, Nepal (M L Dhimal PhD); Global Institute for Interdisciplinary Studies, Kathmandu, Nepal (M L Dhimal PhD); Health Research Section (M Dhimal PhD), Journal of Nepal Health Research Council (P K Hamal MD), Nepal Health Research Council, Kathmandu, Nepal; Center of Complexity Sciences (Prof D Diaz PhD), National Autonomous University of Mexico, Mexico City, Mexico; Faculty of Veterinary Medicine and Zootechnics (Prof D Diaz PhD), Autonomous University of Sinaloa, Culiacán Rosales, Mexico; Department of Parasitology and Mycology (M Didehdar PhD), Department of Pediatrics (J Nazari MD), Arak University of Medical Sciences, Arak, Iran; Institute of Health Economics and Technology, Hanoi, Viet Nam (H T Do MD); Institute for Global Health Innovations (L P Doan MSc), Faculty of Medicine (L P Doan MSc), Duy Tan University, Da Nang, Viet Nam; Faculty of Medicine (M Elhadi MD), University of Tripoli, Tripoli, Libya; Department of Neurological Surgery (J Fares MD), Northwestern University, Chicago, IL, USA; Department of Environmental Health Engineering (A Fatehizadeh PhD), Isfahan University of Medical Sciences, Isfahan, Iran; Department of Nursing (G Fetensa MSc), Department of Public Health (M E Getachew MPH), Wollega University, Nekemte, Ethiopia; Psychiatry Department (I Filip MD), Kaiser Permanente, Fontana, CA, USA; School of Health Sciences (I Filip MD), AT Still University, Mesa, AZ, USA; Institute of Public Health (F Fischer PhD), Charité Universitätsmedizin Berlin (Charité Medical University Berlin), Berlin, Germany; School of Public Health, Medical, and Veterinary Sciences (R C Franklin PhD), James Cook University, Douglas, QLD, Australia; School of Global Health (B Ganesan PhD), Institute of Health & Management, Melbourne, VIC, Australia; Department of Occupational Therapy (B Ganesan PhD), Mahatma Gandhi Occupational Therapy College, Jaipur, India; Department of Nursing (B N B Gameda MSc), Debre Berhan University, Debre Birhan, Ethiopia; Department of Public Health (M E Getachew MPH), Jimma University, Jimma, Ethiopia; School of Public Health (A Ghashghaee BSc), Qazvin University of Medical Sciences, Qazvin, Iran; Adelaide Medical School (T K Gill PhD), Faculty of Health and Medical Sciences (J Klugarová PhD), University of Adelaide, Adelaide, SA, Australia; Health Systems and Policy Research (M Golechha PhD), Indian Institute of Public Health, Gandhinagar, India; Department of Genetics (P Goleij MSc), Sana Institute of Higher Education, Sari, Iran; Department of Public Health (B Gupta PhD), Torrens University Australia, Melbourne, VIC, Australia; Department of Radiology and Radiological Science (N Hafezi-Nejad MD), Johns Hopkins University, Baltimore, MD, USA; Department of Anaesthesiology and Intensive care (P K Hamal MD), National Academy of Medical Sciences, Kathmandu, Nepal; Faculty of Medicine (N I Harlianto BSc), Utrecht University, Utrecht, Netherlands; Department of Radiology (N I Harlianto BSc), University Medical Center Utrecht, Utrecht, Netherlands; Department of Ophthalmology (H Hasani MD), Iran University of Medical Sciences, Karaj, Iran; Faculty of Kinesiology (Prof J J Hebert PhD), University of New Brunswick, Fredericton, NB, Canada; School of Psychology and Exercise Science (Prof J J Hebert PhD), Murdoch University, Murdoch, WA, Australia; Independent Consultant, Santa Clara, CA, USA (G Heidari MD); School of Nursing and Public Health Medicine (M M Hlongwa PhD), University of KwaZulu-Natal, Durban, South Africa; Outpatient Rehabilitation (A K Hsiao DPT), Southcoast Health: Tobey Hospital, Wareham, MA, USA; Department of Public Health (Prof I Iavicoli PhD), University of Naples Federico II, Naples, Italy; Faculty of Medicine (I M Ilic PhD), University of Belgrade, Belgrade, Serbia; Department of Epidemiology (Prof M D Ilic PhD), University of Kragujevac, Kragujevac, Serbia; Institute for Physical Activity and Nutrition (S Islam PhD), Deakin University, Burwood, VIC, Australia; Manipal College of Pharmaceutical Sciences (Prof M D Janodia PhD), Department of Community Medicine (C R Rao MD), Manipal Academy of Higher Education, Manipal, India; Department of Community Medicine (R P Jha MSc), Dr Baba Saheb Ambedkar Medical College & Hospital, Delhi, India; Department of Community Medicine (R P Jha MSc), Banaras Hindu University, Varanasi, India; National Health System Resource Centre (H Jindal MD), Ministry of Health & Family Welfare, New Delhi, India; Institute of Molecular and Clinical Ophthalmology Basel, Basel, Switzerland (Prof J B Jonas MD); Department of Ophthalmology (Prof J B Jonas MD), Heidelberg University, Mannheim, Germany; Sydney Eye Hospital (H Kandel PhD), South Eastern Sydney Local Health District, Sydney, NSW, Australia; Department of Pharmacology (R J Kaur PhD), All India Institute of Medical Sciences, Jodhpur, India; Injury Division (V R Keshri MD), Research and Development Division (L Yadav PhD), The George Institute for Global Health, India, New Delhi, India; The George Institute for Global Health, Faculty of Medicine and Health (V R Keshri MD, S Sharma PhD), University of New South Wales, Sydney, NSW, Australia; Department of Public Health (Prof Y S Khader PhD), Jordan University of Science and Technology, Irbid, Jordan; Department of Epidemiology and Biostatistics (E A Khan MPH), Health Services Academy, Islamabad, Pakistan; Department of Rehabilitation Sciences (M Khan MPH), Hong Kong Polytechnic University, Hong Kong, China; Family Medicine Department (M A Khan MSc), United Arab Emirates University, Al Ain, United Arab Emirates; Primary Care Department (M A Khan MSc), NHS North West London, London, UK; Department of Public Health (Prof J Khubchandani PhD), New Mexico State University, Las Cruces, NM, USA; School of Traditional Chinese Medicine (Y Kim PhD), Xiamen University Malaysia, Sepang, Malaysia; School of Health Sciences (Prof A Kisa PhD), Kristiania University College, Oslo, Norway; Department of International Health and Sustainable Development (Prof A Kisa PhD), Tulane University, New Orleans, LA, USA; Czech National Centre for Evidence-Based Healthcare and Knowledge Translation (J Klugarová PhD), Masaryk University, Brno, Czech Republic; Social Determinants of Health Research Center (H Koohestani PhD), Saveh University of Medical Sciences, Saveh, Iran; Biomedical Research Networking Center for Mental Health Network (CIBERSAM) (A Koyanagi MD), San Juan de Dios Sanitary Park, Sant Boi de Llobregat, Spain; Catalan Institution for Research and Advanced Studies (ICREA), Barcelona, Spain (A Koyanagi MD); Department of Orthopaedics (Prof N Kumar MS), Medanta Hospital, Lucknow, India; Department of Public Health (Prof T Lallukka PhD), University of Helsinki, Helsinki, Finland; Department of Otorhinolaryngology (S Lasrado MS), Father Muller Medical College, Mangalore, India;

The Office of Health Policy & Legislative Affairs (W Lee PhD), University of Texas, Galveston, TX, USA; Department of Preventive Medicine, College of Medicine (Prof Y Lee PhD), Korea University, Seoul, South Korea; Department of Public Health Research (J N Malagón-Rojas MSc), National Institute of Health, Bogota, Colombia; Faculty of Medicine (J N Malagón-Rojas MSc), El Bosque University, Bogota, Colombia; Non-communicable Disease Research Center (Prof R Malekzadeh MD, S G Sepanlou MD), Health Policy Research Center (S Shahabi PhD), Community Based Psychiatric Care Research Center (M Shaygan PhD), Shiraz University of Medical Sciences, Shiraz, Iran; Research Group on Global Health and Human Development (N Malih MD), University of the Balearic Islands (UIB), Palma, Spain; Neurology Department (Prof M Mehndiratta MD), Janakpuri Super Speciality Hospital Society, New Delhi, India; Department of Neurology (Prof M Mehndiratta MD), Govind Ballabh Institute of Medical Education and Research, New Delhi, India; Forensic Medicine Division (Prof R G Menezes MD), Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia; International Dx Department (A A Mentis MD), BGI Genomics, Copenhagen, Denmark; Faculty of Medicine (M K Mesregah MD), Menoufia University, Shebin El-Kom, Egypt; Pacific Institute for Research & Evaluation, Calverton, MD, USA (T R Miller PhD); Social Determinants of Health Center (M Mirza-Aghazadeh-Attari MD), Urmia University of Medical Sciences, Urmia, Iran (R Valizadeh PhD); Non-communicable Disease Research Center (M Mobarakabadi MD), Hamadan University of Medical Sciences, Tehran, Iran; Internal Medicine Department (Y Mohammad MD), King Saud University, Riyadh, Saudi Arabia; Health Systems and Policy Research Unit (S Mohammed PhD), Ahmadu Bello University, Zaria, Nigeria; Department of Health Care Management (S Mohammed PhD), Technical University of Berlin, Berlin, Germany; Clinical Epidemiology and Public Health Research Unit (L Monasta DSc), Burlo Garofolo Institute for Maternal and Child Health, Trieste, Italy; School of Health & Rehabilitation Sciences (M Moni PhD), The University of Queensland, Brisbane, QLD, Australia; Department of Medicine (E Mostafavi PhD), Stanford Cardiovascular Institute (E Mostafavi PhD), Stanford University, Palo Alto, CA, USA; Health Workforce Department (T S Nair MD), World Health Organisation, Geneva, Switzerland; Department of Epidemiology (S Nejadghaderi MD, E Shaker MD), Department of International Studies (P Shobeiri MD), Non-Communicable Diseases Research Center (NCDRC), Tehran, Iran; Department of Health Sciences (S Neupane PhD), University of Tampere, Tampere, Finland; Estia Health Blakehurst (S Neupane Kandel BSN), Estia Health, Sydney, NSW, Australia; Institute for Global Health Innovations (C T Nguyen MPH), Duy Tan University, Hanoi, Viet Nam; Health Promotion Research Center (H Okati-Allabad PhD), Zahedan University of Medical Sciences, Zahedan, Iran; Mass Communication Department (E Omer PhD), Ajman University, Dubai, United Arab Emirates; Department of Epidemiology and Population Health (A Oulhaj PhD), Khalifa University, Abu Dhabi, United Arab Emirates; Department of Medicine (Prof M O Owolabi DrM), University College Hospital, Ibadan, Ibadan, Nigeria; Privatpraxis, Heidelberg, Germany (S Panda-Jonas MD); Department of Medical Humanities and Social Medicine (Prof E Park PhD), Kosin University, Busan, South Korea; Department of Genetics (S Pawar PhD), Yale University, New Haven, CT, USA; Clinical Research Department (P Pedersini MSc), IRCCS Fondazione Don Carlo Gnocchi, Milan, Italy; Department of Orthopedics (J Pereira MS), Yenepoya Medical College, Mangalore, India; International Institute for Educational Planning (IIEP) (Prof M F P Peres MD), Albert Einstein Hospital, São Paulo, Brazil; College of Medicine (A Radfar MD), University of Central Florida, Orlando, FL, USA; Department of Population Science and Human Resource Development (M Rahman DrPH), University of Rajshahi, Rajshahi, Bangladesh; Future Technology Research Center (A Rahmani PhD), National Yunlin University of Science and Technology, Yunlin, Taiwan; University of Social Welfare and Rehabilitation Sciences, Tehran, Iran (V Rashedi PhD); Department of Biomedical Engineering (Z Ratan MSc), Khulna University of Engineering and Technology, Khulna, Bangladesh; School of Health and Society (Z Ratan MSc), University of Wollongong, Wollongong, NSW, Australia; WHO Collaborating Centre for Public Health Education and Training (D L Rawaf MRCS), Department of Primary Care and Public

Health (Prof S Rawaf MD), Imperial College London, London, UK; Inovus Medical, St Helens, UK (D L Rawaf MRCS); Academic Public Health England (Prof S Rawaf MD), Public Health England, London, UK; School of Medicine (Prof A M N Renzaho PhD), Translational Health Research Institute (Prof A M N Renzaho PhD), Western Sydney University, Campbelltown, NSW, Australia; Department of Clinical Research (L Roever PhD), Federal University of Uberlândia, Uberlândia, Brazil; Advanced Campus Governador Valadares (G d Ruela MSc), Juiz de Fora Federal University, Governador Valadares, Brazil; Applied Biomedical Research Center (A Sahebkar PhD), Biotechnology Research Center (A Sahebkar PhD), Mashhad University of Medical Sciences, Mashhad, Iran; Department of Biomedical and Neuromotor Sciences (F Sanmarchi MD), University of Bologna, Bologna, Italy; Department of Neuroimmunology (S Shahrokhi MD), Universal Scientific Research Network (USERN), Tehran, Iran; Amity Institute of Public Health (M Shannawaz PhD), Amity University, Noida, India; Department of Physiotherapy (S Sharma PhD), Kathmandu University, Dhulikhel, Nepal; Finnish Institute of Occupational Health, Helsinki, Finland (R Shiri PhD); Medical Statistics Department (S Shivalli MD), London School of Hygiene & Tropical Medicine, London, UK; Department of Pediatrics and Child Health Nursing (M M Sibhat MSc), Dilla University, Dilla, Ethiopia; School of Medicine (Prof J A Singh MD), University of Alabama at Birmingham, Birmingham, AL, USA; Medicine Service (Prof J A Singh MD), US Department of Veterans Affairs (VA), Birmingham, AL, USA; Department of Neuroscience (M Solmi MD), University of Ottawa, Ottawa, ON, Canada; Department of Medicine (R Somayaji MD), Department of Oncology (L Yang PhD), University of Calgary, Calgary, AB, Canada; Department of Surgery (K Tan PhD), Yong Loo Lin School of Medicine (Prof N Venketasubramanian MBBS), National University of Singapore, Singapore, Singapore; Department of Community Medicine (R Thapar MD), Manipal Academy of Higher Education, Mangalore, India; Neuromuscular Rehabilitation Research Center (S Tohidast PhD), Semnan University of Medical Sciences, Semnan, Iran; Clinical Cancer Research Center (S Valadan Tahbaz PhD, S Yahyazadeh Jabbari MD), Milad General Hospital, Tehran, Iran; Department of Microbiology (S Valadan Tahbaz PhD), Islamic Azad University, Tehran, Iran; UKK Institute, Tampere, Finland (Prof T J Vasankari MD); Faculty of Medicine and Health Technology (Prof T J Vasankari MD), Tampere University, Tampere, Finland; Raffles Neuroscience Centre (Prof N Venketasubramanian MBBS), Raffles Hospital, Singapore; Department of Health Care Administration and Economics (Prof V Vlassov MD), National Research University Higher School of Economics, Moscow, Russia; Faculty of Information Technology (B Vo PhD), HUTECH University, Ho Chi Minh City, Viet Nam; Department of Physical Therapy (T Wiangkham PhD), Naresuan University, Phitsanulok, Thailand; Caring Futures Institute (L Yadav PhD), Flinders University, Adelaide, SA, Australia; Psychology Department (A Yadollahpour PhD), University of Sheffield, Sheffield, UK; Cancer Epidemiology and Prevention Research (L Yang PhD), Alberta Health Services, Calgary, AB, Canada; Department of Neuropsychopharmacology (N Yonemoto PhD), National Center of Neurology and Psychiatry, Kodaira, Japan; Department of Public Health (N Yonemoto PhD), Juntendo University, Tokyo, Japan; Department of Health Policy and Management (Prof M Z Younis PhD), Jackson State University, Jackson, MS, USA; School of Business & Economics (Prof M Z Younis PhD), Universiti Putra Malaysia (University of Putra Malaysia), Kuala Lumpur, Malaysia; Research and Development Department (I Zare BSc), Sina Medical Biochemistry Technologies, Shiraz, Iran; Department of Rheumatology (L M March PhD), Royal North Shore Hospital, St Leonards, NSW, Australia

#### Contributors

G T Culbreth, L M Haile, and J D Steinmetz had full access to all the data in the study and directly accessed and verified the underlying data reported in the manuscript. All authors had access to, and reviewed, estimates. Please see the appendix (pp 24–28) for more detailed information about individual author contributions to the research, divided into the following categories: managing the overall research enterprise; writing the first draft of the manuscript; primary responsibility for applying analytical methods to produce estimates;

primary responsibility for seeking, cataloguing, extracting, or cleaning data; designing or coding figures and tables; providing data or critical feedback on data sources; developing methods or computational machinery; providing critical feedback on methods or results; drafting the manuscript or revising it critically for important intellectual content; and managing the estimation or publications process.

#### Declaration of interests

B Antony reports grants or contacts from Royal Hobart Hospital Foundation as an Investigator who initiated clinical trial funding to institute; Speaker fee paid as travel fee from IRACON 2022; all outside the submitted work. T W Bärnighausen reports research grants from the European Union (Horizon 2020 and EIT Health), German Research Foundation (DFG), US National Institutes of Health, German Ministry of Education and Research, Alexander von Humboldt Foundation, Else-Kröner-Fresenius-Foundation, Wellcome Trust, Bill & Melinda Gates Foundation, KfW, UNAIDS, WHO; consulting fees from KfW on the OSCAR Initiative in Vietnam; participation on the following data safety monitor boards and advisory boards: NIH-funded study “Healthy Options” (PIs: Smith Fawzi, Kaaya), Chair, Data Safety and Monitoring Board (DSMB), German National Committee on the “Future of Public Health Research and Education”, Chair of the scientific advisory board to the EDCTP Evaluation, Member of the UNAIDS Evaluation Expert Advisory Committee, National Institutes of Health Study Section Member on Population and Public Health Approaches to HIV/AIDS (PPAH), US National Academies of Sciences, Engineering, and Medicine’s Committee for the “Evaluation of Human Resources for Health in the Republic of Rwanda under the President’s Emergency Plan for AIDS Relief (PEPFAR)”, University of Pennsylvania (UPenn) Population Aging Research Center (PARC) External Advisory Board Member; and is co-chair of the Global Health HUB Germany; all outside the submitted work. A M Briggs reports grants or contracts from Bone and Joint Decade Foundation, AO Alliance, Canadian Memorial Chiropractic College, Australian Rheumatology Association, Pan-American League of Associations for Rheumatology, World Federation of Chiropractic, Asia Pacific League of Associations for Rheumatology, paid to their institution; consulting fees from WHO; payment for honoraria for lectures, presentations, speakers bureaus, manuscript writing, or educational events from the American College of Rheumatology; support for attending meetings and/or travel from WHO; all outside the submitted work. I Filip and A Radfar report financial support from the Avicenna Medical and Clinical Research Institute; outside the submitted work. R C Franklin reports grants or contracts from Heatwaves in Queensland – Queensland Government, Arc Flash – Human Factors – Queensland Government, and Agricultural Machinery Safety – Agrifutures; honoraria from World Safety Conference 2022 – Conference Convener; support for attending meetings and/or travel from, ACTM – Tropical Medicine and Travel Medicine Conference 2022; Leadership or fiduciary role in other board, society, committee or advocacy group, paid or unpaid, with President – Kidsafe Director – Farmsafe, Director – Auschem, PHAA Injury Prevention SIG Convener, and ISASH – Governance Committee; all outside the submitted work. A-F A Mentis reports grants or contracts from MilkSafe (A novel pipeline to enrich formula milk using omics technologies), a research co-financed by the European Regional Development Fund of the EU and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH - CREATE - INNOVATE (project code: T2EDK-02222), as well as from ELIDEK (Hellenic Foundation for Research and Innovation, MIMS-860); payment as an external peer-reviewer for *Donazione Cariplo*, Italy; serves as an editorial board member for “Systematic Reviews” journal and “Annals of Epidemiology”, and is an associate editor for “Translational Psychiatry”; stocks in a family winery; other financial or non-financial support from the BGI group as a scientific officer. J A Singh reports consulting fees from Crealta/Horizon, Medisys, Fidia, PK Med, Two Labs Inc., Adept Field Solutions, Clinical Care Options, Clearview Healthcare Partners, Putnam Associates, Focus Forward, Navigant Consulting, Spherix, MedIQ, Jupiter Life Science, UBM, Trio Health, Medscape, WebMD, and Practice Point Communications, the National Institutes of Health, and the American College of Rheumatology; payment or honoraria for speakers’ bureaus from Simply Speaking; support for attending

meetings or travel from the steering committee of OMERACT; participation on a Data Safety Monitoring Board or Advisory Board with the US Food and Drug Administration Arthritis Advisory Committee; leadership or fiduciary role in board, society, committee or advocacy group, paid or unpaid, with OMERACT as a steering committee member, with the Veterans Affairs Rheumatology Field Advisory Committee as Chair (unpaid), and with the UAB Cochrane Musculoskeletal Group Satellite Center on Network Meta-analysis and editor and director (unpaid); stock or stock options in TPT Global Tech, Vaxart Pharmaceuticals, Aytu BioPharma, Adaptimmune Therapeutics, GeoVax Labs, Pieris Pharmaceuticals, Enzolytics, Seres Therapeutics, Tonix Pharmaceuticals and Charlotte’s Web Holdings, and previously owned stock options in Amarin, Viking, and Moderna Pharmaceuticals; all outside the submitted work. H Slater reports grants from the Department of Health, Australian Government, Medical Research Future Fund, Department of Health, Western Australian Government, Bone and Joint Decade Foundation of Sweden, Curtin University, Institute for Bone and Joint Research of Australia, Canadian Memorial Chiropractic College, paid directly to their institution; and support for attending meetings/travel from the Australian Pain Society; all outside the submitted work. M Solmi reports payment or honoraria for lectures, presentations, speakers bureaus, manuscript writing or educational events from Angelini, Lundbeck, and Otsuka; all outside the submitted work. All other authors declare no competing interests.

#### Data sharing

Our study follows the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER). The findings of this study are supported by data available in public online repositories, data publicly available upon request of the data provider, and data not publicly available due to restrictions by the data provider. Non-publicly available data were used under license for the current study but may be available from the authors upon reasonable request and with permission of the data provider. Data sources used in this analysis are listed in the appendix (pp 53–80).

#### Acknowledgments

T W Bärnighausen was supported by the Alexander von Humboldt Foundation through the Alexander von Humboldt Professor award, funded by the German Federal Ministry of Education and Research. R Buchbinder is supported by an Australian National Health and Medical Research Council (NHMRC) Investigator Fellowship. M Cross acknowledges support from Global Alliance for Musculoskeletal Health. A Fatehizadeh acknowledges support from the Department of Environmental Health Engineering of Isfahan University of Medical Sciences, Isfahan, Iran. S M S Islam is funded by the National Health and Medical Research Council of Australia (NHMRC) and has received funding from the National Heart Foundation of Australia. H Kandel is a Kornhauser Research Fellow at The University of Sydney. J Khubchandani has received funding from TEVA Pharmaceuticals for Migraine related research. Y J Kim was supported by Research Management Centre, Xiamen University Malaysia (XMUMRF/2020-C6/ITCM/0004). T Lallukka is supported by the Academy of Finland (Grant #330527) and the Social Insurance Institution of Finland (grant 29/26/2020). L Monasta was supported by the Italian Ministry of Health, through a contribution given to the Institute for Maternal and Child Health IRCCS Burlo Garofolo, Trieste, Italy. P Pedersini was supported and funded by the Italian Ministry of Health - Ricerca Corrente 2021. S Sharma is supported by the International Association for the Study of Pain John J Monica Postdoctoral Fellowship. A Singh is supported by International Graduate Research Scholarship, University of Tasmania.

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

#### References

- 1 GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396**: 1204–22.
- 2 Wu A, March L, Zheng X, et al. Global low back pain prevalence and years lived with disability from 1990 to 2017: estimates from the Global Burden of Disease Study 2017. *Ann Transl Med* 2020; **8**: 299.

- 3 Hoy D, March L, Brooks P, et al. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. *Ann Rheum Dis* 2014; **73**: 968–74.
- 4 Chen S, Chen M, Wu X, et al. Global, regional and national burden of low back pain 1990–2019: a systematic analysis of the Global Burden of Disease study 2019. *J Orthop Translat* 2021; **32**: 49–58.
- 5 Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. *Lancet* 2018; **391**: 2356–67.
- 6 Linton SJ, Boersma K, Traczyk M, Shaw W, Nicholas M. Early workplace communication and problem solving to prevent back disability: results of a randomized controlled trial among high-risk workers and their supervisors. *J Occup Rehabil* 2016; **26**: 150–59.
- 7 Buchbinder R, van Tulder M, Öberg B, et al. Low back pain: a call for action. *Lancet* 2018; **391**: 2384–88.
- 8 Foster NE, Anema JR, Cherkin D, et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. *Lancet* 2018; **391**: 2368–83.
- 9 Institute for Health Metrics and Evaluation. Protocol for the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD). 2020. [https://www.healthdata.org/sites/default/files/files/Projects/GBD/March2020\\_GBD%20Protocol\\_v4.pdf](https://www.healthdata.org/sites/default/files/files/Projects/GBD/March2020_GBD%20Protocol_v4.pdf) (accessed Feb 28, 2023).
- 10 Stevens GA, Alkema L, Black RE, et al. Guidelines for Accurate and Transparent Health Estimates Reporting: the GATHER statement. *PLoS Med* 2016; **13**: e1002056.
- 11 GBD 2019 Risk Factors Collaborators. Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396**: 1223–49.
- 12 Driscoll T, Jacklyn G, Orchard J, et al. The global burden of occupationally related low back pain: estimates from the Global Burden of Disease 2010 study. *Ann Rheum Dis* 2014; **73**: 975–81.
- 13 Vollset SE, Goren E, Yuan CW, et al. Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: a forecasting analysis for the Global Burden of Disease Study. *Lancet* 2020; **396**: 1285–306.
- 14 Das Gupta P. A general method of decomposing a difference between two rates into several components. *Demography* 1978; **15**: 99–112.
- 15 Yelin E, Weinstein S, King T. The burden of musculoskeletal diseases in the United States. *Semin Arthritis Rheum* 2016; **46**: 259–60.
- 16 Holliday S, Hayes C, Dunlop A. Opioid use in chronic non-cancer pain—part 1: known knowns and known unknowns. *Aust Fam Physician* 2013; **42**: 98–102.
- 17 Deyo RA, Von Korff M, Duhkoop D. Opioids for low back pain. *BMJ* 2015; **350**: g6380.
- 18 Florence CS, Zhou C, Luo F, Xu L. The economic burden of prescription opioid overdose, abuse, and dependence in the United States, 2013. *Med Care* 2016; **54**: 901–06.
- 19 Carregaro RL, Tottoli CR, Rodrigues DDS, Bosmans JE, da Silva EN, van Tulder M. Low back pain should be considered a health and research priority in Brazil: lost productivity and healthcare costs between 2012 to 2016. *PLoS One* 2020; **15**: e0230902.
- 20 United States Bone and Joint Initiative. The burden of musculoskeletal diseases in the United States, 3rd edn. Chicago, IL: United States Bone and Joint Initiative, 2014.
- 21 Schofield DJ, Shrestha RN, Passey ME, Earnest A, Fletcher SL. Chronic disease and labour force participation among older Australians. *Med J Aust* 2008; **189**: 447–50.
- 22 Schofield DJ, Shrestha RN, Percival R, Callander EJ, Kelly SJ, Passey ME. Early retirement and the financial assets of individuals with back problems. *Eur Spine J* 2011; **20**: 731–36.
- 23 Wickizer TM, Franklin G, Fulton-Kehoe D, et al. Improving quality, preventing disability and reducing costs in workers' compensation healthcare: a population-based intervention study. *Med Care* 2011; **49**: 1105–11.
- 24 Vermeulen SJ, Heymans MW, Anema JR, Schellart AJ, van Mechelen W, van der Beek AJ. Economic evaluation of a participatory return-to-work intervention for temporary agency and unemployed workers sick-listed due to musculoskeletal disorders. *Scand J Work Environ Health* 2013; **39**: 46–56.
- 25 Dionne CE, Dunn KM, Croft PR. Does back pain prevalence really decrease with increasing age? A systematic review. *Age Ageing* 2006; **35**: 229–34.
- 26 Rudy TE, Weiner DK, Lieber SJ, Slaboda J, Boston RJ. The impact of chronic low back pain on older adults: a comparative study of patients and controls. *Pain* 2007; **131**: 293–301.
- 27 Rundell SD, Sherman KJ, Heagerty PJ, Mock CN, Jarvik JG. The clinical course of pain and function in older adults with a new primary care visit for back pain. *J Am Geriatr Soc* 2015; **63**: 524–30.
- 28 WHO. Integrated care for older people (ICOPE): guidance for person-centred assessment and pathways in primary care. Geneva: World Health Organization, 2019.
- 29 Roffey DM, Wai EK, Bishop P, Kwon BK, Dagenais S. Causal assessment of occupational standing or walking and low back pain: results of a systematic review. *Spine J* 2010; **10**: 262–72.
- 30 Wai EK, Roffey DM, Bishop P, Kwon BK, Dagenais S. Causal assessment of occupational lifting and low back pain: results of a systematic review. *Spine J* 2010; **10**: 554–66.
- 31 Shiri R, Falah-Hassani K. The effect of smoking on the risk of sciatica: a meta-analysis. *Am J Med* 2016; **129**: 64–73.e20.
- 32 Elgaeva EE, Tsepilov Y, Freidin MB, Williams FMK, Aulchenko Y, Suri P. ISSLS Prize in Clinical Science 2020. Examining causal effects of body mass index on back pain: a Mendelian randomization study. *Eur Spine J* 2020; **29**: 686–91.
- 33 Hoy DG, Raikoti T, Smith E, et al. Use of The Global Alliance for Musculoskeletal Health survey module for estimating the population prevalence of musculoskeletal pain: findings from the Solomon Islands. *BMC Musculoskelet Disord* 2018; **19**: 292.
- 34 Tamrakar M, Kharel P, Traeger A, Maher C, O'Keefe M, Ferreira G. Completeness and quality of low back pain prevalence data in the Global Burden of Disease Study 2017. *BMJ Glob Health* 2021; **6**: e005847.