BMC Gastroenterology

RESEARCH

Open Access

Spatiotemporal trends in hernia disease burden and health workforce correlations in aging populations: a global analysis with projections to 2050

Fangyi Dai[1], Yuzhou Cai[1], Huayou Luo[1], Ruo Shu[1], Tong Zhang[1] and Yong Dai[2*]

Abstract

Background Inguinal, femoral, and abdominal wall hernias represent significant health and economic burdens globally, particularly among adults aged 45 and older. In 2021, the Global Burden of Disease Study reported 1.72 million new cases, 6.75 million prevalent cases, and over 41,000 deaths in this population. While age-standardized rates have declined with improved healthcare, absolute burden continues to rise due to population growth and aging. Gender disparities remain pronounced, with men experiencing sevenfold higher incidence than women. This study analyzes global hernia trends, determinants, future projections, and the association between health workforce distribution and hernia burden to inform targeted interventions.

Methods Using data from the Global Burden of Disease Study 2021, we analyzed incidence, prevalence, mortality, and disability-adjusted life years (DALYs) for inguinal, femoral, and abdominal wall hernias. Long-term trends were assessed using average annual percentage change (EAPC), with decomposition analyses exploring factors influencing disease burden changes. Spatial and temporal patterns were examined using age-period-cohort and frontier analyses. We conducted health inequality analyses and utilized eight time-series machine learning models to project disease burden from 2022 to 2050. Additionally, we analyzed correlations between health workforce distribution and hernia burden across 204 countries and territories for 1990 and 2019.

Results In 2021, global incidence of hernias was 1,720,177, with 6,748,203 prevalent cases and 41,834 deaths among individuals aged 45 years and older. Although age-standardized incidence rate (ASIR) decreased from 153.98/100,000 in 1990 to 112.29/100,000 in 2021 (EAPC = -0.83%, 95% CI: -0.95% to -0.70%), and age-standardized mortality rate (ASMR) decreased from 3.19/100,000 to 1.86/100,000 (EAPC = -1.77%, 95% CI: -1.94% to -1.59%), absolute burden continued increasing. Socioeconomic differences were significant, with higher ASIR in high SDI areas (141.94/100,000) than low SDI areas (104.60/100,000) in 2021, but much higher ASMR in low SDI areas (4.14/100,000) than high SDI areas (1.23/100,000). Decomposition analysis revealed population growth as the main driver of increased disease burden, contributing 173.80% to incidence increases. Age-period-cohort analysis showed incidence peaked in the 65–69 age group (RR = 1.43, 95% CI: 1.42–1.43). Male ASIR in 2021 (203.41/100,000) was approximately 7.3 times higher than female ASIR (27.94/100,000). Correlation analyses revealed significant negative associations between pharmaceutical personnel density and hernia disease burden, with correlation coefficients

*Correspondence:
Yong Dai
qhdaiyong@163.com
Full list of author information is available at the end of the article

strengthening from 1990 (DALYs: $r = -0.39$, $p < 0.001$) to 2019 (DALYs: $r = -0.57$, $p < 0.001$). Similar trends were observed for dentistry personnel (DALYs: r = -0.26 in 1990 to $r = -0.47$ in 2019, $p < 0.001$). Countries with high hernia burden (Guatemala, Paraguay, Indonesia) consistently demonstrated lower health workforce density compared to low-burden countries. ARIMA model projections showed that by 2050, ASIR would increase slightly from 112.32/100,000 in 2022 to 112.64/100,000, with absolute new cases increasing by 19.70%. ASMR is projected to increase from 1.84/100,000 to 2.11/100,000, with deaths increasing by 8.50%.

Conclusions Despite declining age-standardized rates for inguinal, femoral, and abdominal wall hernias, absolute disease burden continues increasing due to demographic factors. Socioeconomic development significantly impacts disease patterns, with higher morbidity but lower mortality in high SDI areas. The strong negative correlation between pharmaceutical and dentistry personnel density and hernia burden suggests potential protective effects of healthcare workforce investment, particularly in resource-constrained settings. Future projections indicate growing absolute burden despite relatively stable age-standardized rates, highlighting the urgent need to strengthen preventive measures, improve treatments, and strategically allocate health workforce resources to address this growing public health challenge.

Keywords Inguinal hernia, Global burden of disease, Health workforce, Epidemiology, Health inequality, Machine learning prediction

Introduction

Hernias, particularly inguinal, femoral, and abdominal wall types [1], represent a significant global health challenge with substantial clinical and economic implications. These conditions are characterized by the protrusion of abdominal contents through weakened areas of the abdominal wall, manifesting as a heavy or dragging sensation, burning sensation, sharp pain, or discomfort during coughing, defecation, micturition, or exercise [2]. In severe cases, complications such as incarceration and strangulation can lead to significant morbidity and mortality [3]. Despite advancements in surgical techniques and healthcare systems, hernias remain a persistent challenge, with approximately 20 million individuals worldwide undergoing inguinal hernia surgery annually [3, 4].

Gender disparities in hernia incidence are particularly pronounced, with male predominance consistently observed worldwide. Studies from the United Kingdom indicate an inguinal hernia incidence of 247 per 100,000 patients, with more recent data showing admission rates of 217 per 100,000 for males and only 9.4 per 100,000 for females [5]. This substantial gender differential is attributed to anatomical differences, with males having a larger potential weak point in the inguinal canal and more strenuous physical activities that increase intra-abdominal pressure [4, 6, 7]. Socioeconomic factors significantly influence hernia patterns across regions. Studies have demonstrated higher age-standardized incidence rates in high sociodemographic index (SDI) areas compared to low SDI areas, while mortality rates show an inverse relationship, with higher rates in low SDI areas than in high SDI regions [8].This disparity underscores the impact of healthcare access and quality on hernia outcomes, with frontier analyses across 204 countries and territories linking higher SDIs with reduced hernia prevalence, though with notable exceptions [9].

The management of hernias presents significant challenges globally. While the Lichtenstein technique remains the gold standard for inguinal hernia repair in many regions [4, 9, 10], access to surgical care varies dramatically worldwide. Recent trends in hernia management include the adoption of mesh repair, minimally invasive approaches, and specialized hernia centers in high-resource settings [11, 12], However, in low-resource environments, traditional tissue repair techniques remain common due to cost constraints and limited specialized training. Surgical site infections, chronic pain, and recurrence rates continue to challenge clinicians across all practice settings.

Health workforce distribution represents a critical yet understudied dimension in global hernia management. While previous studies have investigated the relationship between surgical workforce density and surgical outcomes for various conditions, few have specifically examined how the broader healthcare workforce impacts hernia burden. Research on healthcare accessibility suggests that pharmaceutical and dental personnel often serve as important healthcare access points in many communities, potentially influencing referral patterns and health-seeking behaviors for conditions like hernias. However, the specific relationship between these workforce elements and hernia outcomes remains largely unexplored. Despite advances in surgical techniques and improved healthcare access in some regions, projections indicate that the absolute burden of hernias will continue to rise globally. Previous studies utilizing Bayesian age-period-cohort models have forecast increasing prevalence through 2030, predominantly affecting males [9].

However, existing projections have limitations in modeling techniques and timeframes, with most extending only to 2030 or 2035 [8].

To address these knowledge gaps, our study employs a combination of eight machine learning algorithms, including Prophet, ARIMA, TBATS, ElasticNet, ETS, VAR, HoltWinters, and Theta, to generate comprehensive projections of hernia burden in middle-aged and older adults from 2022 to 2050. This multi-model approach allows for the integration of multiple forecasting techniques, enabling us to capture complex temporal patterns and uncertainties in hernia epidemiology. Additionally, we analyze the correlation between health workforce distribution and hernia burden across different countries and territories, providing novel insights into how healthcare resource allocation may influence disease patterns.

By elucidating the interplay between demographic trends, socioeconomic factors, health workforce distribution, and hernia burden, this study aims to inform evidence-based policies and interventions. Our findings seek to address critical gaps in understanding the long-term trajectory of hernia burden and the potential role of healthcare workforce planning in mitigating this growing public health challenge, particularly in aging populations and resource-limited settings.

Materials and methods

Data source

This study utilized data from the Global Burden of Disease Study 2021 (GBD 2021) database (https://ghdx.healthdata.org/gbd-2021), which provides comprehensive estimates for 204 countries and territories, 371 diseases and injuries, and 88 risk factors. We extracted data on incidence, prevalence, disability-adjusted life years (DALYs), and mortality for Inguinal, Femoral, and Abdominal Hernia. Both absolute numbers and age-standardized rates per 100,000 population were obtained for the population aged 45 years and above, stratified by sex (both sexes combined, male, and female). The study period spanned from 1990 to 2021 [13–16].

Disease definition

According to the GBD 2021 hierarchy, diseases and injuries are typically classified into four main levels. Inguinal, Femoral, and Abdominal Hernia falls under the third level of the second-level category of digestive system diseases, which is part of the first-level category of non-communicable diseases. Based on the International Classification of Diseases (ICD)− 10, Inguinal, Femoral, and Abdominal Hernia is primarily coded within the range K40-K42.9 and K44-K46.9 [15, 16].

Estimated annual percentage change (EAPC) analysis

To quantify the long-term trends in the age-standardized rates (ASR) of disease burden, we calculated the estimated annual percentage change (EAPC). This was done by fitting a simple linear regression model to the natural logarithm of ASR against the year. The slope of the regression line represents the EAPC, indicating the average annual percentage change. The EAPC and its 95% confidence interval were derived from the regression coefficient and its standard error.

Age-period-cohort (APC) analysis

To investigate the effects of age, period, and birth cohort on the disease burden, we constructed an age-period-cohort (APC) model. This generalized linear model incorporates age, period, and birth cohort as independent variables, with the disease burden measure as the dependent variable.

Frontier analysis

We employed frontier analysis to assess the relative performance of different countries and regions in health outcomes. Using Data Envelopment Analysis (DEA), we constructed a frontier surface representing the best possible health outcomes achievable at given input levels. We then calculated the distance of each country or region from this frontier, termed the efficiency score, to measure their relative efficiency in health improvement.

Health inequality analysis

To examine health inequalities in the global disease burden, we utilized the Slope Index of Inequality (SII) and the Concentration Index. The SII measures the absolute inequality in health variables across different socioeconomic groups, representing the health difference between the lowest and highest socioeconomic status groups. The Concentration Index quantifies the degree of inequality in health variables across socioeconomic groups, ranging from − 1 to 1, with 0 indicating perfect equality.

Decomposition analysis

To further explore factors contributing to differences in global disease burden, we applied decomposition analysis. This method allows for the disaggregation of overall health differences into contributions from various factors, such as population growth, population aging, and epidemiological changes.

Socio-demographic index (SDI)

The Socio-demographic Index (SDI), developed by GBD researchers, is a composite indicator of development

status closely related to health outcomes. It is the geometric mean of indices ranging from 0 to 1 for total fertility rate under 25 (TFU25), mean education for those aged 15 and older (EDU15 +), and lag distributed income (LDI) per capita. An SDI of 0 represents the theoretical minimum level of development relevant to health, while an SDI of 1 represents the theoretical maximum level (https://ghdx.healthdata.org/record/global-burden-disease-study-2021-gbd-2021-socio-demographic-index-sdi). We applied LOESS smoothing to visualize trends and conducted Spearman correlation tests to quantify the relationship between SDI and disease burden indicators.

Machine learning models for disease burden prediction

Our study utilized two authoritative data sources: age-standardized rates from the Global Burden of Disease (GBD) database for 1990–2021 and population data from 1990–2050 [17]. To enhance model predictive power, we conducted extensive feature engineering. This process included normalizing time and population data to eliminate scale effects, constructing lag features (one and two-year lags) to capture short-term trends, calculating 3-year moving averages to smooth short-term fluctuations, and creating interaction terms between population and year to explore joint effects.

We employed eight advanced time series prediction methods and machine learning algorithms: 1. Prophet Model: Developed by Facebook, this model is particularly suited for time series data with strong seasonality. We optimized model parameters using grid search, applied data scaling techniques, and implemented growth constraints and smoothing to enhance prediction stability; 2. ARIMA Model: This classic time series prediction method was enhanced with non-linear external regression variables, Box-Cox transformation, and dynamic smoothing constraints to improve its non-linear expression capability; 3. TBATS Model: We used a simplified ETS (Error, Trend, Seasonal) model as the foundation, incorporating additive errors, additive trends, and no seasonality, with damped trends to prevent long-term prediction divergence; 4. Elastic Net Model: This linear regression method combines Ridge and Lasso regression. We incorporated non-linear features and used grid search to optimize alpha and lambda parameters; 5. ETS Model: We employed an additive seasonal ETS model with fixed smoothing parameters and added non-linear adjustments including logarithmic trends and cyclical fluctuations; 6. VAR Model: This multivariate time series model was enhanced with non-linear features and dynamic smoothing constraints to capture complex relationships between variables; 7. Modified Holt-Winters Model: We combined quadratic curve fitting with exponential smoothing, implementing change rate constraints and error handling mechanisms; 8. Improved Theta Model with Seasonal Fluctuations: Based on the standard Theta model, we added periodic fluctuations and random growth trends to capture seasonality and non-linear trends.

We implemented a rigorous cross-validation method and comprehensive evaluation metrics to ensure model robustness and predictive ability. Data from 1990–2010 was used as the training set, 2011–2021 as the validation set, and 2022–2050 as the final prediction set. We employed six evaluation metrics: Mean Squared Error (MSE), Mean Absolute Percentage Error (MAPE), Root Mean Squared Error (RMSE), Symmetric Mean Absolute Percentage Error (SMAPE), Coefficient of Determination (R^2), and Mean Absolute Scaled Error (MASE). This comprehensive evaluation system allowed us to assess each model's predictive performance from multiple perspectives, considering both absolute and relative errors, explanatory power, and performance relative to simple benchmark models.

For optimal model selection, we prioritized validation set performance with a specific focus on MAPE and R^2 values. MAPE was chosen as a primary indicator because it provides an intuitive percentage measure of prediction accuracy that is comparable across different scales of data, while R^2 was selected to ensure the model adequately captured the variance in the observed data. We systematically evaluated all eight models against these metrics for each disease burden measure. Models showing the lowest MAPE combined with the highest R^2 values on the validation set were identified as the most reliable for forecasting future trends. This selection approach ensured that our final projections were based on models that demonstrated both high accuracy (low relative error) and strong explanatory power when tested on historical data not used in the training process, thus maximizing confidence in the long-term forecasts to 2050.

Statistical analysis

All data processing, statistical analyses, and visualizations were performed using R version 4.4.1. We calculated age-standardized rates using the GBD 2021 global age-standard population. Uncertainty intervals (UIs) were generated using the 2.5 th and 97.5 th percentiles of 1000 draw-level estimates for each quantity of interest.

Results

Global burden of inguinal, femoral and abdominal hernia in adults aged 45 and above: 1990–2021

The global burden of disease related to inguinal, femoral, and abdominal wall hernias among individuals aged 45 years and older demonstrated significant changes

Fig. 1 Global, SDI-specific, and regional trends in age-standardized rates of inguinal, femoral, and abdominal hernia for both sexes combined (aged 45 + years), 1990–2021. **A** Age-standardized incidence rate. **B** Age-standardized prevalence rate. **C** Age-standardized DALY rate. **D** Age-standardized mortality rate

between 1990 and 2021 (Figs. 1, 2, 3 and 4). Key findings reveal notable trends in incidence, prevalence, mortality, and DALYs over this period. In 2021, the global number of new cases was estimated at 1,720,177 (95% UI: 1,051,360–2,646,143), corresponding to an age-standardized incidence rate of 112.29 per 100,000 population (95% UI: 69.40–171.35). This reflects a decline from 1990, when the age-standardized incidence rate was 153.98 per 100,000 (95% UI: 94.38–236.22), with an EAPC of − 0.83% (95% CI: − 0.95% to − 0.70%) (Table 1). While the absolute number of cases rose from 4,643,614 in 1990 to 6,748,203 in 2021, the age-standardized prevalence rate decreased from 419.47 per 100,000 to 280.61 per 100,000, with an EAPC of − 1.47% (95% CI: − 1.51% to − 1.42%) (Table 2). Similarly, DALYs attributable to these hernias increased in absolute numbers from 882,459 in 1990 to 1,204,089 in 2021. However, the age-standardized DALY rate decreased from 84.68 per 100,000 to 51.12 per

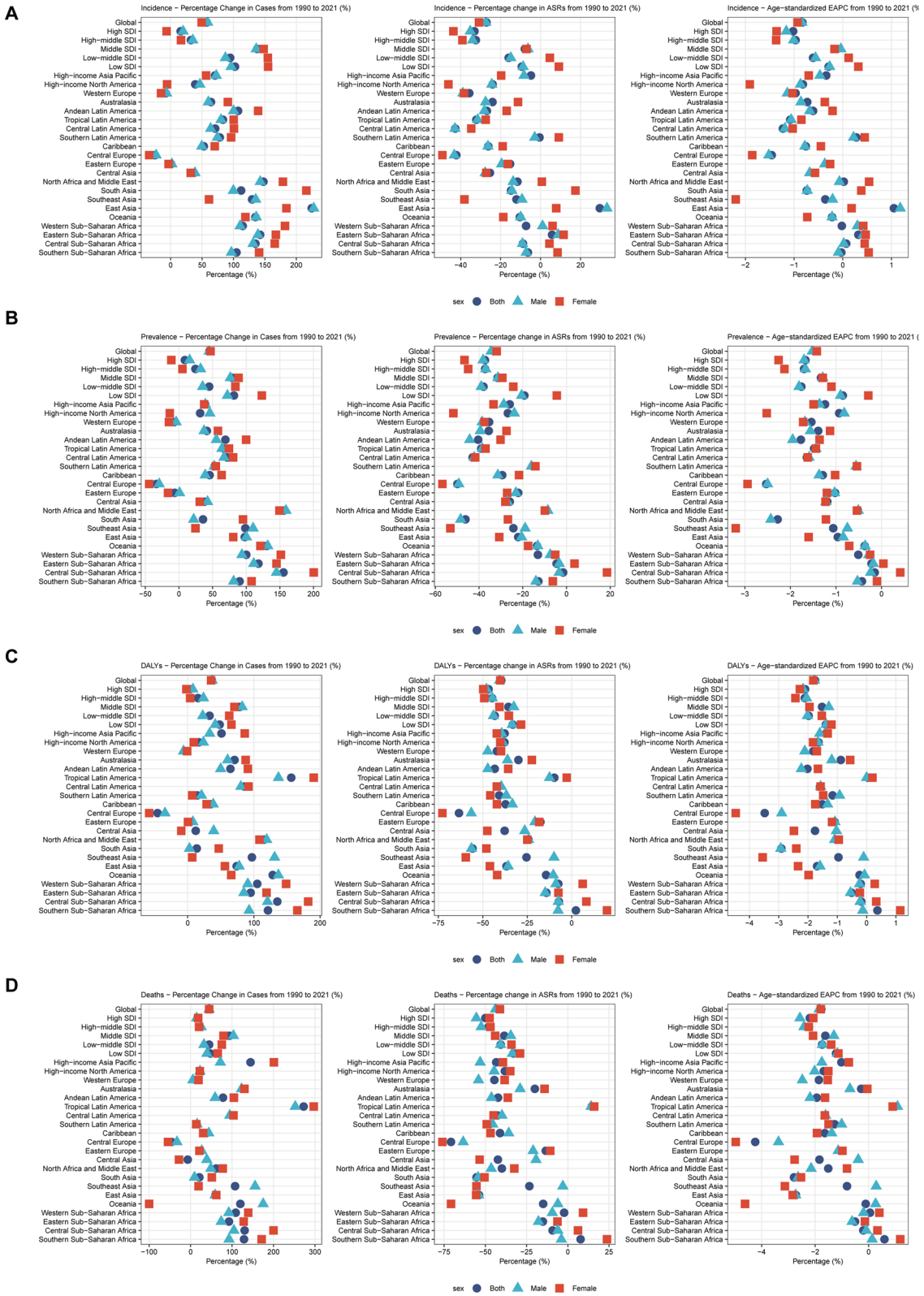

Fig. 2 Percentage change in absolute numbers, age-standardized rates, and EAPC in age-standardized rates of inguinal, femoral, and abdominal hernia globally, by SDI quintile, and region for both sexes combined, males, and females (aged 45 + years), 1990–2021. **A** Incidence. **B** Prevalence. **C** DALYs. **D** Mortality

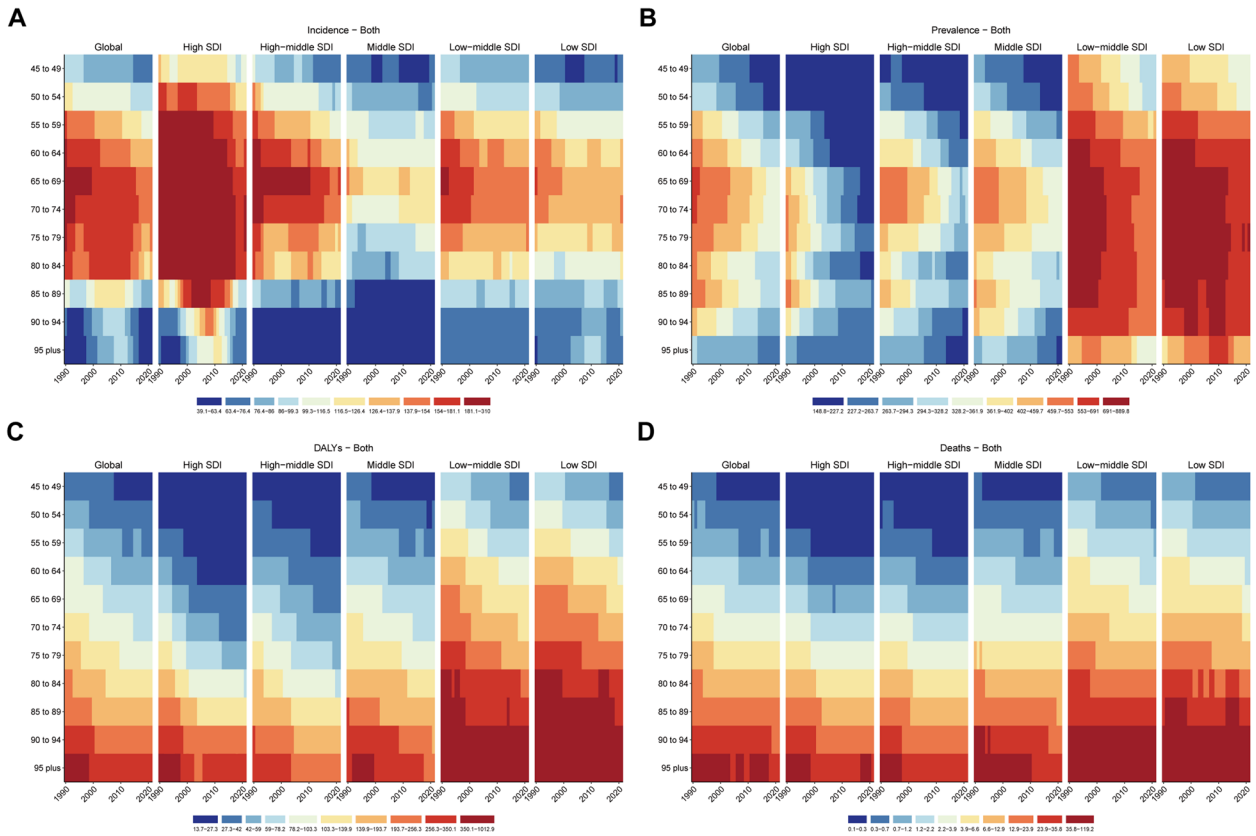

Fig. 3 Age-specific trends in age-standardized rates of inguinal, femoral, and abdominal hernia globally and by SDI quintile for both sexes combined (aged 45 + years, in 5-year age groups), 1990–2021. **A** Age-standardized incidence rate. **B** Age-standardized prevalence rate. **C** Age-standardized DALY rate. **D** Age-standardized mortality rate

100,000, with an EAPC of − 1.76% (95% CI: − 1.88% to − 1.63%) (Table 3). Mortality trends also showed a mixed pattern. While the total number of deaths rose from 28,918 in 1990 to 41,834 in 2021, the age-standardized mortality rate declined from 3.19 per 100,000 to 1.86 per 100,000, with an EAPC of − 1.77% (95% CI: − 1.94% to − 1.59%) (Table 4).

Age-specific trends in inguinal, femoral and abdominal hernia burden: a global analysis, 1990–2021

The burden of inguinal, femoral, and abdominal wall hernias demonstrated diverse trends across different age groups from 1990 to 2021 (Figs. 1, 2, 3 and 4). In terms of prevalence, the age-standardized prevalence rate in 2021 was 76.12 per 100,000 population (95% UI: 45.07–122.80) in the 45–49 age group, compared to 57.88 per 100,000 (95% UI: 39.34–80.01) in the 90–94 age group (Table 1). Furthermore, the crude prevalence rate was 219.48 per 100,000 (95% UI: 144.54–323.70) for individuals aged 45–49, rising to 272.41 per 100,000 (95% UI: 221.00–334.23) for those aged 90–94 (Table 2). The analysis of DALYs revealed that in 2021, the age-standardized DALY rate was 24.02 per 100,000 (95% UI: 17.63–33.22) in the 45–49 age group, increasing substantially to 209.66 per 100,000 (95% UI: 170.87–235.47) in the 90–94 age group (Table 3). Mortality data showed a similar trend, with an age-standardized mortality rate of 0.21 per 100,000 (95% UI: 0.18–0.27) for the 45–49 age group and 22.51 per 100,000 (95% UI: 18.11–25.35) for the 90–94 age group in 2021 (Table 4).

Socio-demographic disparities in inguinal, femoral and abdominal hernia burden: a global perspective

There were significant differences in the burden of disease for inguinal, femoral and abdominal wall hernias in different SDI regions (Figs. 1, 2, 3 and 4). In 2021, the age-standardized incidence rate was 141.94 (95% UI: 86.67–219.45)/100,000 in the high SDI regions, compared to 104.60 (95% UI: 64.54–159.00)/100,000 (Table 1). For prevalence, it was 192.33 (95% UI: 124.69–284.98)/100,000 in high SDI areas, while it amounted to 501.01 (95% UI: 352.95–682.29)/100,000 in low SDI areas (Table 2). Data on DALYs showed 31.11 (95% UI: 24.25–39.41)/100,000 in high SDI areas and up

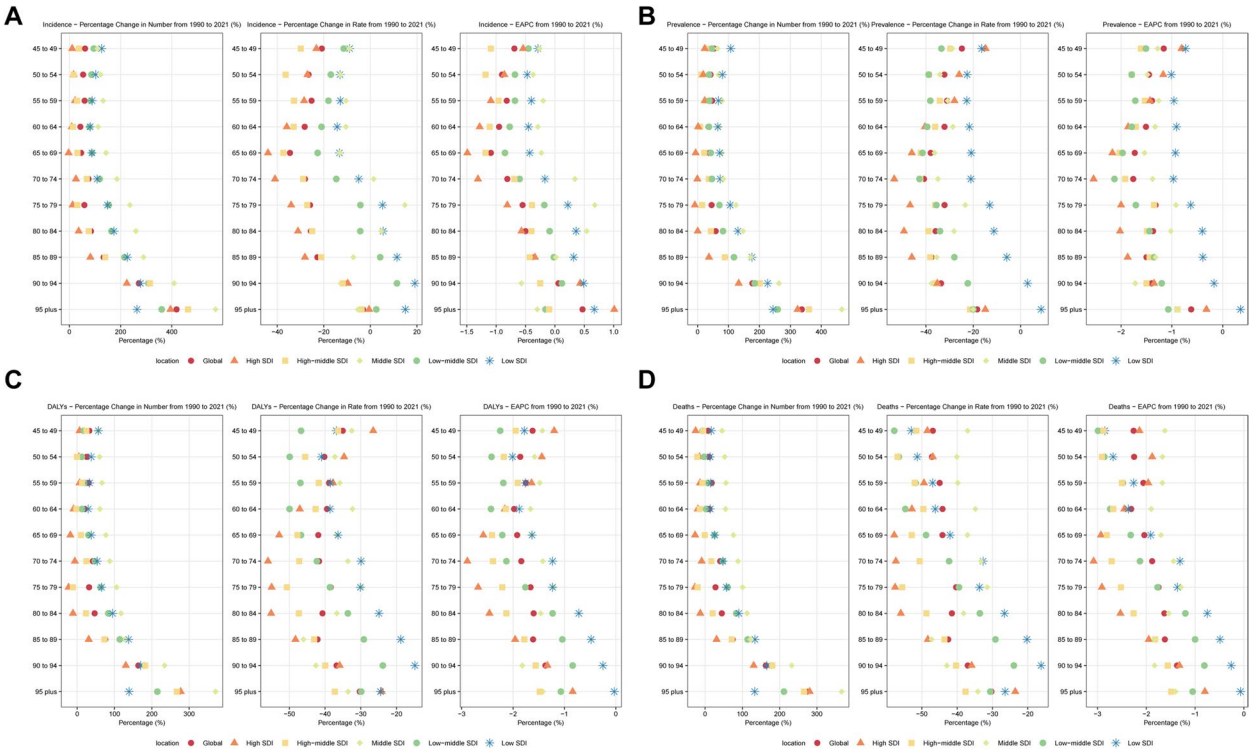

Fig. 4 Percentage change in absolute numbers, age-standardized rates, and EAPC in age-standardized rates of inguinal, femoral, and abdominal hernia globally and by SDI quintile for both sexes combined (aged 45 + years), 1990–2021. **A** Incidence. **B** Prevalence. **C** DALYs. **D** Mortality

to 105.00 (95% UI: 77.13–159.40)/100,000 in low SDI areas (Table 3). Mortality analysis showed 1.23 (95% UI: 1.04–1.34)/100,000 in high SDI areas and 4.14 (95% UI: 2.86–7.00)/100,000 in low SDI areas (Table 4). Notably, age-standardized incidence rates, prevalence rates, DALYs, and mortality rates trended downward between 1990 and 2021 in all SDI regions, with the greatest decline in the high SDI regions with an incidence EAPC of − 1.02 (95% CI: − 1.35 to − 0.70).

Regional variations in inguinal, femoral and abdominal hernia burden: analysis of 21 GBD regions

The burden of disease showed significant geographic variation across the 21 Global Burden of Disease (GBD) regions (Figs. 1, 2, 3 and 4). The incidence, prevalence, DALYs, and mortality rates in 2021 differed significantly between regions. In terms of prevalence, it was highest in Western Europe at 217.11 (95% UI: 134.19–331.50)/100,000, while it was lowest in East Asia at 63.70 (95% UI: 37.35–101.65)/100,000 (Table 1). Prevalence data showed that South Asia had the highest at 423.83 (95% UI: 288.67–588.44)/100,000, while East Asia had the lowest at 130.35 (95% UI: 78.98–199.80)/100,000 (Table 2). Regarding DALYs, Central and Latin America had the highest burden at 115.83 (95% UI: 97.45–137.28)/100,000, while the East Asia region had the lowest burden at 11.92 (95% UI: 7.48–18.11)/100,000 (Table 3). Mortality data showed that the Central and Latin American region had the highest at 4.38 (95% UI: 3.78–4.90)/100,000, while East Asia had the lowest at 0.24 (95% UI: 0.18–0.31)/100,000 (Table 4). Most regions showed a decreasing trend in all four indicators between 1990 and 2021, with Central Europe showing the most significant EAPC in DALYs at − 3.48 (95% CI: − 3.75 to − 3.21). However, some regions such as East Asia showed an increasing trend in incidence and tropical Latin America in mortality, with an EAPC of 1.05 (95% CI: 0.88 to 1.22) and 0.98 (95% CI: 0.72 to 1.23), respectively.

Country-level changes in inguinal, femoralGlobal, regional and age-specific and abdominal hernia burden: 1990–2021

Changes in the burden of disease showed diverse trends across countries (Figs. 5, 6 and 7). In terms of incidence, Georgia showed the fastest growth, with an age-standardized incidence rate of 126.18 (95% UI: 83.47–180.01) per 100,000 in 2021 and an EAPC of 1.35 (95% CI: 0.78–1.92). In contrast, Mongolia had the fastest declining prevalence, falling to 70.98 (95% UI: 41.26–113.60) per 100,000 in 2021, with an EAPC of − 2.66 (95% CI: − 2.92 to − 2.41) (Table 5). Georgia

Table 1 Global, regional, and age-specific incidence of inguinal, femoral, and abdominal hernia in population aged 45 years and above, 1990–2021

Variables	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Global	1,720,177.273(1,051,359.908 to 2,646,142.764)	1,720,177.273(1,051,359.908 to 2,646,142.764)	153.977(94.378 to 236.215)	112.287(69.401 to 171.35)	– 0.826 (– 0.953 to – 0.699)
Age group (years):					
45–49	223,246.906(130,318.995 to 358,011.871)	360,426.222(213,408.882 to 581,454.323)	96.146(56.125 to 154.186)	76.119(45.07 to 122.798)	– 0.688 (– 0.774 to – 0.602)
50–54	266,019.915(152,266.091 to 430,914.282)	409,213.321(240,827.252 to 659,989.58)	125.144(71.631 to 202.715)	91.974(54.128 to 148.338)	– 0.895 (– 0.992 to – 0.798)
55–59	287,113.284(171,582.96 to 455,366.095)	458,499.592(278,952.111 to 730,209.062)	155.029(92.647 to 245.878)	115.862(70.491 to 184.523)	– 0.819 (– 0.878 to – 0.759)
60–64	297,614.321(189,601.359 to 443,302.646)	425,761.153(266,478.307 to 638,125.053)	185.303(118.051 to 276.013)	133.03(83.262 to 199.384)	– 0.949 (– 1.069 to – 0.828)
65–69	272,941.507(166,638.074 to 413,322.255)	398,786.993(242,795.169 to 596,915.018)	220.81(134.81 to 334.378)	144.571(88.02 to 216.397)	– 1.092 (– 1.229 to – 0.955)
70–74	176,625.813(112,932.086 to 271,412.713)	308,789.422(198,874.033 to 463,054.755)	208.627(133.393 to 320.587)	150.015(96.616 to 224.959)	– 0.815 (– 0.972 to – 0.657)
75–79	116,971.47(73,963.58 to 165,425.213)	185,680.212(119,813.909 to 256,640.425)	190.026(120.158 to 268.742)	140.79(90.848 to 194.595)	– 0.547 (– 0.825 to – 0.269)
80–84	60,204.021(40,744.652 to 81,935.082)	110,949.539(75,802.082 to 147,009.916)	170.184(115.176 to 231.613)	126.679(86.549 to 167.852)	– 0.5 (– 0.849 to – 0.149)
85–89	16,037.688(11,198.775 to 21,385.176)	37,484.532(26,610.889 to 47,988.71)	106.132(74.11 to 141.52)	81.984(58.202 to 104.958)	– 0.387 (– 0.891 to 0.12)
90–94	2786.945(1784.861 to 4058.419)	10,353.756(7037.386 to 14,312.354)	65.037(41.652 to 94.708)	57.877(39.338 to 80.005)	0.058 (– 0.617 to 0.737)
SDI level:					
High	618,815.581(376,451.455 to 949,402.452)	717,531.489(443,222.492 to 1,095,921.928)	212.181(128.553 to 327.27)	141.944(86.667 to 219.453)	– 1.023 (– 1.35 to – 0.695)
High-middle	463,681.207(283,121.637 to 714,769.658)	613,408.738(378,716.144 to 938,121.106)	165.202(100.946 to 254.568)	111.645(68.892 to 170.79)	– 0.968 (– 1.125 to – 0.812)
Middle	311,159.63(187,526.836 to 478,921.276)	739,646.117(456,542.426 to 1,132,732.89)	101.892(61.623 to 156.229)	93.849(58.155 to 143.11)	– 0.115 (– 0.224 to – 0.007)
Low-middle	246,011.795(148,092.528 to 382,250.799)	479,071.872(294,479.802 to 733,503.553)	136.555(82.373 to 211.606)	114.75(70.73 to 174.906)	– 0.606 (– 0.708 to – 0.503)
Low	77,304.344(45,879.311 to 121,473.058)	156,493.323(96,346.925 to 239,304.951)	115.458(68.592 to 180.934)	104.595(64.537 to 159)	– 0.292 (– 0.409 to – 0.174)
GBD regions:					
Australasia	8004.119(5018.111 to 12,096.752)	13,140.946(8335.848 to 19,783.806)	127.375(79.297 to 193.809)	96.716(60.416 to 147.752)	– 0.725 (– 0.81 to – 0.64)
Caribbean	10,159.258(6334.825 to 15,548.594)	15,526.054(9940.34 to 23,258.815)	141.32(88.219 to 216.056)	104.346(66.849 to 156.295)	– 0.757 (– 0.845 to – 0.669)
Central Asia	16,144.096(10,058.251 to 24,774.272)	22,144.037(13,698.741 to 34,058.15)	116.925(72.646 to 179.493)	87.27(54.211 to 133.46)	– 0.614 (– 0.846 to – 0.382)
Central Europe	140,083.776(87,783.212 to 209,709.76)	105,378.216(67,255.876 to 157,721.124)	336.503(210.121 to 506.162)	194.568(122.768 to 294.393)	– 1.464 (– 1.688 to – 1.24)
Central Latin America	63,162.101(38,838.844 to 95,242.863)	107,968.47(69,633.654 to 158,409.362)	264.981(163.541 to 398.518)	151.861(98.272 to 222.074)	– 1.227 (– 1.526 to – 0.926)
Central Sub-Saharan Africa	5546.519(3330.052 to 8601.333)	13,033.666(8356.952 to 19,396.86)	82.815(49.699 to 127.866)	75.506(48.434 to 111.467)	0.068 (– 0.182 to 0.319)
East Asia	125,789.442(72,198.281 to 202,666.367)	408,256.462(238,133.887 to 654,341.678)	49.137(28.315 to 78.847)	63.697(37.348 to 101.651)	1.049 (0.875 to 1.224)
Eastern Europe	149,609.702(88,419.675 to 234,395.276)	150,797.33(91,467.543 to 234,512.742)	193.007(113.838 to 303.364)	163.57(98.668 to 255.51)	– 0.267 (– 0.43 to – 0.103)

Table 1 (continued)

Variables	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Eastern Sub-Saharan Africa	18,605.544(11,107.887 to 28,854.661)	45,099.719(28,095.818 to 67,479.937)	84.657(50.52 to 131.179)	89.513(55.868 to 133.35)	0.321 (0.209 to 0.432)
High-income Asia Pacific	87,073.073(51,672.467 to 137,297.929)	148,554.516(88,942.414 to 234,635.939)	152.722(90.84 to 240.338)	145.339(85.946 to 232.654)	− 0.339 (− 0.529 to − 0.148)
High-income North America	89,755.644(53,883.463 to 139,979.767)	124,905.874(76,883.162 to 191,495.3)	98.055(58.334 to 154.37)	74.508(45.337 to 115.169)	− 0.817 (− 1.065 to − 0.568)
North Africa and Middle East	61,423.277(35,127.947 to 99,276.523)	152,127.06(88,858.635 to 244,452.352)	120.554(69.212 to 194.258)	106.601(62.792 to 169.79)	0.02 (− 0.169 to 0.21)
Oceania	558.105(332.461 to 865.996)	1311.401(811.54 to 1998.222)	62.23(37.201 to 96.201)	55.767(34.734 to 84.251)	− 0.221 (− 0.278 to − 0.164)
South Asia	256,375.924(152,619.044 to 399,276.733)	544,044.933(323,858.873 to 854,198.386)	149.924(89.399 to 232.768)	127.71(76.207 to 199.741)	− 0.742 (− 0.884 to − 0.6)
Southeast Asia	85,766.941(51,946.348 to 131,485.503)	196,940.636(128,326.854 to 285,196.065)	115.034(69.817 to 176.159)	101.12(66.088 to 145.813)	− 0.361 (− 0.489 to − 0.232)
Southern Latin America	14,361.176(9044.067 to 22,045.146)	25,585.551(16,635.888 to 37,385.43)	111.968(70.4 to 172.078)	111.359(72.133 to 163.266)	0.284 (0.187 to 0.382)
Southern Sub-Saharan Africa	5455.395(3274.699 to 8379.543)	11,175.212(7026.017 to 16,771.604)	69.858(42.087 to 106.868)	65.421(41.334 to 97.584)	− 0.031 (− 0.098 to 0.035)
Tropical Latin America	48,735.123(29,744.396 to 73,630.485)	89,291.307(55,986.827 to 133,517.212)	181.843(111.2 to 274.038)	123.37(77.402 to 184.312)	− 1.079 (− 1.23 to − 0.927)
Western Europe	499,273.649(304,499.296 to 763,947.905)	460,837.139(288,347.455 to 693,968.337)	337.621(204.662 to 520.894)	217.114(134.189 to 331.501)	− 0.965 (− 1.525 to − 0.401)
Western Sub-Saharan Africa	25,906.933(15,376.899 to 40,581.165)	55,625.7(34,525.419 to 83,627.147)	99.372(59.081 to 155.333)	92.145(57.482 to 137.682)	− 0.016 (− 0.121 to 0.088)

also had the fastest growing prevalence, reaching 373.69 (95% UI: 279.48 to 489.44)/100,000 in 2021, with an EAPC of 1.64 (95% CI: 1.48 to 1.80). Mongolia had the fastest decline in prevalence, 281.50 (95% UI: 182.43–411.47)/100,000 in 2021, with an EAPC of − 3.80 (95% CI: − 4.01 to − 3.60) (Table 6). Data on DALYs show that American Samoa is the fastest growing, reaching 69.75 (95% UI: 37.54–111.51)/100,000 in 2021 with an EAPC of 2.07 (95% CI: 1.33–2.82). Puerto Rico had the fastest decline, to 33.37 (95% UI: 23.85–46.36)/100,000 in 2021, with an EAPC of − 4.70 (95% CI: − 5.85 to − 3.54) (Table 7).

In terms of mortality, Kuwait is the fastest growing, reaching 0.35 (95% UI: 0.26–0.44)/100,000 in 2021, with an EAPC of 4.88 (95% CI: 3.21–6.58). Puerto Rico declined the fastest, to 1.00 (95% UI: 0.77–1.24)/100,000 in 2021, with an EAPC of − 6.11 (95% CI: − 7.78 to − 4.40) (Table 8). Notably, the number of incidence cases increased significantly in China, from 119,904.85 in 1990 to 397,651.89 in 2021, reflecting the potential impact of population aging and other factors.

Decomposition analysis of global inguinal, femoral and abdominal hernia burden: 1990–2021

Changes in the global burden of disease are influenced by multiple factors (Fig. 8A-D). In terms of prevalence, the overall global variance was 988,958.00 cases, with population growth contributing the most at 173.80%, while epidemiologic changes resulted in a 74.69% decrease (Table 9). The prevalence analysis showed an overall difference of 2,104,588.68 cases, with population growth contributing 213.46% and epidemiologic changes leading to a 115.63% reduction (Table 10). The analysis of DALYs showed an overall variance of 321,629.41 years, with population growth contributing 259.68% and epidemiologic changes resulting in a 176.53% reduction (Table 11). For mortality, the overall difference was 12,915.52 cases, with population growth contributing 218.55% and epidemiologic changes leading to a reduction of 161.40% (Table 12). In terms of gender differences, males showed a greater magnitude of change than females in all indicators. For example, in the morbidity analysis, the overall difference in males was 871,356.36 cases compared to

Table 2 Global, regional, and age-specific prevalence of inguinal, femoral, and abdominal hernia in population aged 45 years and above, 1990–2021

Variables	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Global	4,643,613.945(3,237,413.498 to 6,335,307.205)	6,748,202.628(4,674,740.123 to 9,407,742.761)	419.466(294.161 to 569.756)	280.611(194.761 to 390.638)	– 1.465 (– 1.507 to – 1.423)
Age group (years):					
45–49	677,856.476(427,525.058 to 981,646.198)	1,039,257.998(684,408.628 to 1,532,738.993)	291.934(184.123 to 422.767)	219.482(144.541 to 323.701)	– 1.156 (– 1.226 to – 1.087)
50–54	694,867.85(451,604.852 to 1,007,466.292)	986,120.739(639,798.194 to 1,457,266.368)	326.887(212.448 to 473.942)	221.639(143.8 to 327.532)	– 1.451 (– 1.505 to – 1.398)
55–59	751,417.94(505,842.041 to 1,058,748.178)	1,106,467.183(740,168.754 to 1,605,235.804)	405.733(273.133 to 571.678)	279.603(187.04 to 405.641)	– 1.388 (– 1.46 to – 1.315)
60–64	761,449.59(536,633.348 to 1,030,035.731)	1,029,367.114(717,667.113 to 1,416,200.696)	474.101(334.124 to 641.33)	321.629(224.237 to 442.497)	– 1.509 (– 1.576 to – 1.442)
65–69	695,071.666(505,526.853 to 916,900.214)	961,874.789(680,408.078 to 1,294,915.192)	562.313(408.971 to 741.772)	348.705(246.666 to 469.441)	– 1.728 (– 1.778 to – 1.679)
70–74	484,337.795(353,589.37 to 627,533.536)	696,843.344(491,185.99 to 941,254.867)	572.09(417.652 to 741.23)	338.538(238.626 to 457.277)	– 1.762 (– 1.79 to – 1.734)
75–79	314,629.663(246,909.638 to 389,711.887)	457,429.185(351,003.129 to 574,433.275)	511.132(401.117 to 633.106)	346.841(266.145 to 435.558)	– 1.323 (– 1.359 to – 1.288)
80–84	167,247.485(131,389.56 to 205,106.063)	265,230.789(204,934.293 to 333,232.162)	472.772(371.41 to 579.79)	302.833(233.989 to 380.476)	– 1.367 (– 1.467 to – 1.267)
85–89	76,118.493(61,723.266 to 92,930.821)	143,609.552(115,250.4 to 175,805.904)	503.727(408.464 to 614.985)	314.094(252.069 to 384.512)	– 1.499 (– 1.6 to – 1.398)
90–94	17,581.325(14,288.084 to 21,382.561)	48,732.947(39,535.934 to 59,792.308)	410.281(333.43 to 498.988)	272.413(221.002 to 334.234)	– 1.402 (– 1.454 to – 1.35)
SDI level:					
High	899,979.131(614,053.687 to 1,267,386.674)	979,072.988(647,068.483 to 1,425,647.275)	306.677(206.929 to 435.992)	192.326(124.692 to 284.977)	– 1.671 (– 1.777 to – 1.564)
High-middle	978,572.648(665,210.248 to 1,373,196.295)	1,217,811.979(811,424.104 to 1,748,244.17)	354.414(241.916 to 495.943)	222.501(148.222 to 319.842)	– 1.704 (– 1.801 to – 1.607)
Middle	1,164,568.417(806,938.738 to 1,598,614.309)	2,085,501.46(1,445,604.968 to 2,902,366.21)	390.091(273.181 to 531.356)	267.195(186.434 to 369.679)	– 1.327 (– 1.361 to – 1.292)
Low-middle	1,186,548.752(852,170.06 to 1,587,616.457)	1,719,767.877(1,216,848.885 to 2,342,998.827)	671.697(485.663 to 894.142)	416.69(296.932 to 564.098)	– 1.755 (– 1.817 to – 1.693)
Low	406,724.036(282,869.426 to 558,671.592)	739,107.295(517,579.279 to 1,012,655.886)	620.641(433.903 to 849.107)	501.008(352.952 to 682.289)	– 0.847 (– 0.895 to – 0.798)
GBD regions:					
Andean Latin America	36,330.473(26,255.461 to 48,632.495)	61,408.24(43,804.325 to 84,243.514)	617.781(448.353 to 823.493)	368.303(263.638 to 503.286)	– 1.771 (– 1.812 to – 1.731)
Australasia	17,032.442(11,528.77 to 24,393.295)	24,091.369(16,279.426 to 34,572.636)	271.013(181.776 to 391.595)	174.634(115.4 to 255.538)	– 1.387 (– 1.525 to – 1.248)
Caribbean	38,680.169(27,217.35 to 52,997.803)	56,309.324(40,112.107 to 76,797.037)	537.085(378.335 to 735.096)	379.183(270.226 to 517.104)	– 1.292 (– 1.332 to – 1.251)
Central Asia	54,524.07(38,143.655 to 75,214.254)	75,123.273(50,646.483 to 106,942.644)	406.028(285.561 to 558.079)	300.685(204.984 to 424.209)	– 1.186 (– 1.368 to – 1.005)
Central Europe	288,914.647(211,541.903 to 383,047.558)	191,973.421(131,442.962 to 271,576.381)	701.125(511.551 to 932.202)	351.391(236.573 to 505.306)	– 2.527 (– 2.623 to – 2.43)
Central Latin America	227,137.986(167,334.052 to 301,157.781)	389,781.265(289,705.79 to 518,149.485)	964.074(716.867 to 1266.922)	550.164(410.592 to 727.925)	– 1.645 (– 1.86 to – 1.429)
Central Sub-Saharan Africa	25,799.566(18,400.848 to 34,907.664)	65,886.308(48,947.355 to 87,590.488)	398.338(284.514 to 537.176)	392.218(293.219 to 516.179)	– 0.147 (– 0.178 to – 0.115)
East Asia	419,582.102(254,838.881 to 639,963.803)	830,008.599(499,384.339 to 1,276,700.945)	167.298(102.991 to 252.809)	130.351(78.983 to 199.8)	– 0.961 (– 1.078 to – 0.844)

Table 2 (continued)

Variables	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Eastern Europe	331,059.558(221,269.586 to 469,589.913)	310,314.457(207,086.02 to 444,934.698)	432.493(288.525 to 615.041)	337.006(222.998 to 487.294)	– 1.018 (– 1.199 to – 0.837)
Eastern Sub-Saharan Africa	94,808.416(66,577.169 to 130,343.239)	206,790.445(148,089.553 to 280,781.698)	437.596(307.828 to 599.344)	417.723(300.077 to 563.173)	– 0.221 (– 0.244 to – 0.198)
High-income Asia Pacific	140,250.652(88,031.264 to 211,547.2)	194,737.402(124,128.036 to 289,265.111)	249.831(158.107 to 374.567)	184.914(114.721 to 280.922)	– 1.244 (– 1.413 to – 1.074)
High-income North America	152,959.514(100,787.446 to 221,134.018)	201,145.624(130,831.985 to 295,409.815)	165.304(106.759 to 242.861)	120.963(77.3 to 180.247)	– 0.932 (– 1.258 to – 0.604)
North Africa and Middle East	174,126.627(101,962.179 to 267,103.168)	445,307.283(278,030.761 to 675,797.454)	336.469(198.706 to 513.815)	306.349(192.688 to 460.544)	– 0.52 (– 0.674 to – 0.367)
Oceania	2468.75(1682.081 to 3460.659)	5692.922(4006.471 to 7858.993)	284.921(195.888 to 395.02)	246.488(175.285 to 335.616)	– 0.372 (– 0.426 to – 0.317)
South Asia	1,312,021.744(941,720.221 to 1,754,661.638)	1,780,822.126(1,203,183.872 to 2,486,794.98)	787.895(570.209 to 1046.818)	423.825(288.667 to 588.442)	– 2.28 (– 2.368 to – 2.192)
Southeast Asia	317,969.985(223,293.04 to 435,070.028)	631,624.404(466,356.794 to 835,350.014)	440.052(310.303 to 598.885)	333.108(247.526 to 437.465)	– 1.06 (– 1.182 to – 0.938)
Southern Latin America	46,838.565(32,943.767 to 64,718.408)	71,717.714(51,507.665 to 97,614.637)	367.116(258.082 to 507.657)	310.921(221.846 to 425.745)	– 0.541 (– 0.582 to – 0.499)
Southern Sub-Saharan Africa	27,379.773(19,448.321 to 36,975.8)	52,060.934(38,209.476 to 69,397.051)	353.31(252.517 to 474.735)	307.858(227.76 to 407.147)	– 0.429 (– 0.492 to – 0.366)
Tropical Latin America	201,088.791(148,371.703 to 266,147.833)	335,159.884(247,976.521 to 445,167.854)	762.7(566.218 to 1003.223)	465.269(344.851 to 616.939)	– 1.48 (– 1.658 to – 1.302)
Western Europe	609,045.148(416,092.961 to 859,913.222)	567,006.881(385,959.472 to 810,759.434)	406.435(272.299 to 583.894)	262.611(174.951 to 383.208)	– 1.54 (– 1.598 to – 1.482)
Western Sub-Saharan Africa	125,594.966(86,457.885 to 174,346.966)	251,240.753(181,200.151 to 340,626.153)	491.88(340.21 to 679.855)	427.501(310.127 to 574.901)	– 0.509 (– 0.584 to – 0.435)

117,601.64 cases in females (Table 9). In the prevalence analysis, the overall difference was 1,595,855.53 cases for males and 508,733.16 cases for females (Table 10). It is noteworthy that the impact of aging on the burden of disease was positive in all indicators, especially most significant in the mortality analysis, which accounted for 42.85% of the overall difference (Table 12).

SDI-stratified decomposition of inguinal, femoral and abdominal hernia burden: 1990–2021

Changes in the burden of disease in different SDI regions showed unique characteristics (Fig. 8). In terms of morbidity, the greatest overall variation was observed in medium SDI regions with 428,486.49 cases, of which population growth contributed 110.36%, while epidemiologic changes resulted in a decrease of 11.08% (Table 9). Although the overall variation was smaller in the high SDI region (98,715.91 cases), the impact of population growth was the most significant, contributing 385.75%, while epidemiologic changes resulted in a 291.99% reduction, reflecting significant advances in preventive and curative approaches in the region (Fig. 9A). The prevalence analysis showed that the medium SDI region had the highest overall variance of 920,933.04 cases, with population growth contributing 169.72% and epidemiologic changes leading to a 72.08% reduction (Table 10). The low SDI region, although the overall difference was smaller (332,383.26 cases), the aging of the population instead led to a decrease of 1.96%, which may be related to the demographic and health conditions of the region (Fig. 9B). The analysis of DALYs showed that the medium SDI region had the greatest overall variation of 163,685.33 years, with population growth contributing 171.37%, while epidemiologic changes led to a reduction of 83.31% (Table 11). Although the overall variation was smaller in the high SDI region (6,064.73 years), the effect of aging was the most significant, contributing 402.30%, reflecting the important impact of population aging on the burden of disease in the region (Fig. 9C). Regarding mortality, the medium SDI region showed the highest overall variation of 5,773.83 cases, with population growth contributing 150.46% and epidemiologic changes leading to an 80.94% reduction (Table 12). Although the overall difference was smaller in high SDI areas (1,229.49 cases), the effect of aging was most significant, contributing 197.84% (Fig. 9D). In terms of gender differences, the

Table 3 Global, regional, and age-specific DALYs due to inguinal, femoral, and abdominal hernia in population aged 45 years and above, 1990–2021

Variables	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Global	882,459.417(715,137.164 to 1,118,267.319)	1,204,088.827(980,185.697 to 1,496,033.22)	84.68(69.019 to 106.683)	51.117(41.671 to 63.349)	– 1.755 (– 1.877 to – 1.633)
Age group (years):					
45–49	85,882.637(64,712.831 to 113,381.793)	113,752.071(83,473.502 to 157,288.566)	36.987(27.87 to 48.83)	24.023(17.629 to 33.218)	– 1.621 (– 1.724 to – 1.518)
50–54	101,116.151(77,135.829 to 133,325.602)	126,567.96(93,856.17 to 168,588.3)	47.568(36.287 to 62.72)	28.447(21.095 to 37.892)	– 1.859 (– 2.007 to – 1.709)
55–59	116,779.892(91,773.688 to 154,435.982)	152,473.225(119,301.905 to 199,603.078)	63.056(49.554 to 83.389)	38.53(30.147 to 50.439)	– 1.746 (– 1.926 to – 1.567)
60–64	131,265.643(105,727.478 to 165,646.83)	158,363.745(128,632.36 to 198,061.588)	81.73(65.829 to 103.137)	49.481(40.192 to 61.885)	– 1.98 (– 2.115 to – 1.844)
65–69	126,527.006(102,145.615 to 160,248.39)	164,038.668(134,057.002 to 201,858.492)	102.36(82.636 to 129.641)	59.468(48.599 to 73.179)	– 1.919 (– 2.014 to – 1.824)
70–74	102,411.516(84,664.033 to 128,218.929)	145,220.167(124,493.991 to 173,074.022)	120.966(100.003 to 151.45)	70.55(60.481 to 84.082)	– 1.842 (– 1.946 to – 1.738)
75–79	91,599.09(79,370.781 to 111,799.438)	120,847.337(106,148.026 to 143,594.787)	148.807(128.942 to 181.624)	91.631(80.486 to 108.879)	– 1.659 (– 1.782 to – 1.536)
80–84	70,315.97(60,684.526 to 84,744.696)	103,190.185(90,894.906 to 118,291.291)	198.768(171.542 to 239.555)	117.82(103.781 to 135.062)	– 1.597 (– 1.772 to – 1.423)
85–89	38,334.105(33,563.85 to 44,994.969)	67,146.436(57,318.436 to 76,511.061)	253.682(222.114 to 297.762)	146.859(125.363 to 167.34)	– 1.615 (– 1.819 to – 1.41)
90–94	14,212.745(12,109.081 to 16,729.241)	37,506.879(30,567.994 to 42,124.046)	331.671(282.58 to 390.397)	209.66(170.872 to 235.47)	– 1.369 (– 1.549 to – 1.189)
SDI level:					
High	175,016.968(146,812.241 to 210,149.627)	181,081.698(143,078.104 to 223,531.716)	58.439(48.576 to 70.717)	31.107(24.25 to 39.408)	– 2.096 (– 2.409 to – 1.781)
High-middle	149,973.551(121,789.885 to 186,807.484)	173,156.83(135,026.293 to 222,015.651)	57.841(47.289 to 71.274)	31.938(24.902 to 40.928)	– 2.109 (– 2.183 to – 2.035)
Middle	208,337.185(162,457.664 to 273,846.222)	372,022.513(301,829.4 to 458,007.23)	78.529(61.634 to 103.06)	50.584(41.232 to 61.837)	– 1.524 (– 1.591 to – 1.457)
Low-middle	256,153.796(194,863.781 to 358,636.425)	340,735.083(274,158.111 to 446,005.703)	158.756(120.142 to 223.708)	90.034(72.747 to 117.626)	– 1.977 (– 2.111 to – 1.843)
Low	91,658.879(67,390.952 to 139,121.674)	135,888.817(100,032.83 to 204,513.424)	156.992(114.212 to 243.526)	104.995(77.126 to 159.4)	– 1.388 (– 1.517 to – 1.259)
GBD regions:					
Andean Latin America	6017.676(4438.652 to 7879.991)	9902.329(7399.789 to 13,083.407)	107.395(79.373 to 140.321)	60.913(45.631 to 80.305)	– 2.015 (– 2.202 to – 1.828)
Australasia	3173.056(2528.078 to 3977.834)	5417.804(4198.449 to 6771.097)	50.449(39.946 to 63.551)	35.331(27.072 to 44.934)	– 0.88 (– 1.201 to – 0.558)
Caribbean	8439.31(6984.913 to 10,269.984)	11,362.57(9044.234 to 14,122.956)	121.72(100.845 to 147.816)	76.401(60.818 to 94.971)	– 1.506 (– 1.806 to – 1.206)
Central Asia	7807.018(6207.688 to 9882.01)	8755.075(6482.959 to 11,757.142)	60.017(47.976 to 75.621)	37.393(28.195 to 49.353)	– 1.763 (– 1.922 to – 1.604)
Central Europe	48,138.316(40,542.782 to 57,543.695)	26,223.866(20,597.673 to 33,738.766)	121.695(102.648 to 144.882)	44.559(34.216 to 58.665)	– 3.483 (– 3.754 to – 3.211)
Central Latin America	42,748.287(36,642.89 to 50,243.509)	79,357.373(66,543.222 to 94,454.579)	196.831(170.214 to 228.771)	115.826(97.449 to 137.276)	– 1.589 (– 1.953 to – 1.223)
Central Sub-Saharan Africa	5284.106(3320.784 to 8664.592)	12,438.46(7552.426 to 19,996.979)	95.902(59.027 to 164.572)	88.975(52.096 to 149.477)	– 0.177 (– 0.216 to – 0.139)
East Asia	41,663.705(27,274.596 to 61,920.859)	72,461.606(44,624.4 to 111,458.306)	18.824(12.74 to 27.49)	11.916(7.482 to 18.11)	– 1.687 (– 1.842 to – 1.532)

Table 3 (continued)

Variables	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Eastern Europe	49,044.183(39,839.449 to 61,399.031)	50,915.278(41,203.756 to 63,318.162)	65.05(52.819 to 81.373)	53.599(42.998 to 67.276)	– 1.088 (– 1.231 to – 0.944)
Eastern Sub-Saharan Africa	20,895.11(14,515.908 to 39,291.382)	40,762.759(28,140.623 to 76,196.123)	109.616(75.177 to 213.422)	94.031(64.404 to 180.407)	– 0.514 (– 0.583 to – 0.444)
High-income Asia Pacific	16,714.952(12,288.983 to 22,816.13)	25,251.977(17,595.403 to 34,452.61)	31.096(23.074 to 41.908)	19.373(12.965 to 27.996)	– 1.379 (– 1.715 to – 1.041)
High-income North America	46,100.801(40,057.629 to 52,697.856)	53,881.659(44,881.612 to 63,690.019)	48.124(41.585 to 55.439)	29.906(24.798 to 35.791)	– 1.64 (– 2.152 to – 1.125)
North Africa and Middle East	17,871.551(11,602.684 to 26,648.994)	38,449.76(24,453.339 to 58,438.423)	37.632(24.844 to 55.874)	28.476(18.574 to 42.678)	– 1.027 (– 1.116 to – 0.938)
Oceania	278.072(173.418 to 512.884)	634.645(397.687 to 1094.113)	35.206(22.358 to 65.626)	30.144(18.949 to 52.879)	– 0.242 (– 0.37 to – 0.114)
South Asia	300,402.523(226,232.744 to 410,205.836)	341,517.941(259,839.291 to 459,049.963)	199.424(148.824 to 274.623)	88.222(67.048 to 118.482)	– 2.908 (– 3.079 to – 2.737)
Southeast Asia	87,946.648(62,221.838 to 136,346.077)	173,257.805(121,928.805 to 218,810.534)	133.938(94.015 to 208.596)	99.875(70.652 to 125.841)	– 0.955 (– 1.01 to – 0.901)
Southern Latin America	11,430.775(9680.355 to 13,584.989)	13,073.457(10,574.972 to 16,131.023)	92.688(78.452 to 109.95)	54.904(44.172 to 68.169)	– 1.164 (– 1.599 to – 0.727)
Southern Sub-Saharan Africa	5745.211(4228.787 to 8357.344)	12,711.055(10,347.224 to 15,367.865)	79.041(57.98 to 115.129)	80.904(66.047 to 97.489)	0.373 (0.166 to 0.58)
Tropical Latin America	29,803.977(24,539.643 to 36,254.699)	76,423.356(65,326.695 to 89,119.934)	120.521(100.006 to 145.034)	108.732(92.981 to 126.54)	0.046 (– 0.186 to 0.278)
Western Europe	111,285.969(92,175.109 to 134,997.93)	106,853.069(84,435.838 to 131,877.757)	70.655(57.587 to 87.094)	40.918(31.653 to 52.381)	– 1.818 (– 1.982 to – 1.654)
Western Sub-Saharan Africa	21,668.17(14,694.296 to 42,127.739)	44,436.984(30,301.487 to 84,300.565)	95.394(64.405 to 190.071)	88.219(60.148 to 172.599)	– 0.199 (– 0.281 to – 0.118)

overall differences were greater for males than females in most of the SDI areas, especially in terms of incidence and prevalence. For example, in the analysis of prevalence in high SDI regions, the overall difference for males was 104,641.12 cases compared to − 5,925.22 cases for females (Table 9).

Regional disparities in inguinal, femoral and abdominal hernia burden: a decomposition study

Changes in the burden of disease in the 21 GBD regions showed significant geographic variation (Fig. 8A-H). In terms of prevalence, East Asia showed the highest overall variation of 282,467.02 cases, where population growth contributed 76.51% and epidemiologic changes resulted in 22.26% increase, which was the only region with positive epidemiologic changes (Table 9). Prevalence analysis showed that South Asia had the highest overall variation of 468,800.38 cases, with population growth contributing 319.39% and epidemiologic changes leading to a 227.79% decrease (Table 10). In terms of DALYs, the greatest overall variation was observed in Southeast Asia with 85,311.16 years, where population growth contributed 146.26% while epidemiologic changes resulted in 50.87% reduction (Table 11). Mortality analysis showed the greatest overall variation in East Asia at 433.98 cases, with population aging and population growth contributing 94.01% and 213.82%, respectively, while epidemiologic changes resulted in a 207.83% reduction (Table 12). The analysis of gender differences showed that the overall difference was greater for males than for females in most indicators and regions. For example, in the prevalence analysis in East Asia, the overall difference was 265,819.42 cases for males and only 16,647.60 cases for females (Table 9). In the prevalence analysis in South Asia, the overall difference was 232,624.22 cases in males and 236,176.16 cases in females (Table 10). In DALYs analysis, the overall difference in Southeast Asia was 83,639.59 years for males and only 1,671.57 years for females (Table 11). However, in the mortality analysis, in some regions such as Western Europe and South Asia, the overall difference for females was rather greater than that for males (Table 12). It is worth noting that the impact of population ageing varies across regions and across indicators. In the high-income Asia–Pacific region, the most significant contribution

Table 4 Global, regional, and age-specific mortality of inguinal, femoral, and abdominal hernia in population aged 45 years and above, 1990–2021

Variables	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Global	28,918.4(24,115.009 to 37,282.745)	41,833.915(35,456.134 to 49,353.679)	3.193(2.668 to 4.059)	1.863(1.576 to 2.194)	– 1.765 (– 1.94 to – 1.59)
Age group (years):					
45–49	934.406(746.134 to 1279.283)	1011.994(846.877 to 1265.621)	0.402(0.321 to 0.551)	0.214(0.179 to 0.267)	– 2.257 (– 2.435 to – 2.078)
50–54	1432.225(1148.053 to 1973.359)	1584.877(1333.525 to 2028.878)	0.674(0.54 to 0.928)	0.356(0.3 to 0.456)	– 2.248 (– 2.512 to – 1.985)
55–59	2005.846(1599.516 to 2770.192)	2359.605(2006.805 to 2862.361)	1.083(0.864 to 1.496)	0.596(0.507 to 0.723)	– 2.06 (– 2.345 to – 1.775)
60–64	2827.894(2324.633 to 3818.129)	3147.951(2739.881 to 3775.091)	1.761(1.447 to 2.377)	0.984(0.856 to 1.18)	– 2.306 (– 2.496 to – 2.116)
65–69	3368.687(2743.681 to 4586.815)	4197.693(3598.244 to 5028.951)	2.725(2.22 to 3.711)	1.522(1.304 to 1.823)	– 2.039 (– 2.178 to – 1.901)
70–74	3596.251(2988.12 to 4708.435)	5052.253(4401.198 to 6020.109)	4.248(3.53 to 5.562)	2.454(2.138 to 2.925)	– 1.881 (– 2.03 to – 1.731)
75–79	4526.255(3863.478 to 5801.701)	5789.47(4996.844 to 6967.761)	7.353(6.276 to 9.425)	4.39(3.789 to 5.283)	– 1.752 (– 1.906 to – 1.598)
80–84	4815.862(4125.509 to 5910.227)	6975.932(5989.144 to 8075.433)	13.613(11.662 to 16.707)	7.965(6.838 to 9.22)	– 1.634 (– 1.832 to – 1.436)
85–89	3407.267(2918.46 to 4067.313)	5923.885(4975.465 to 6788.23)	22.548(19.313 to 26.916)	12.956(10.882 to 14.847)	– 1.622 (– 1.842 to – 1.402)
90–94	1531.075(1279.635 to 1806.948)	4026.442(3239.338 to 4534.136)	35.729(29.862 to 42.167)	22.507(18.108 to 25.345)	– 1.366 (– 1.56 to – 1.171)
SDI level:					
High	7386.396(6680.008 to 7817.985)	8615.882(7133.127 to 9461.778)	2.459(2.21 to 2.609)	1.23(1.036 to 1.342)	– 2.204 (– 2.637 to – 1.768)
High-middle	4644.492(4240.979 to 4989.478)	5711.129(4906.142 to 6326.425)	2.104(1.898 to 2.263)	1.088(0.931 to 1.207)	– 2.23 (– 2.397 to – 2.063)
Middle	6171.487(4762.334 to 8499.877)	11,945.316(9768.789 to 13,976.585)	3.011(2.34 to 4.114)	1.851(1.515 to 2.161)	– 1.618 (– 1.686 to – 1.55)
Low-middle	7845.204(5648.702 to 11,916.972)	11,350.909(9191.937 to 15,358.789)	5.966(4.261 to 9.067)	3.543(2.859 to 4.777)	– 1.742 (– 1.917 to – 1.567)
Low	2824.879(1920.702 to 4809.477)	4168.212(2881.508 to 7088.826)	6.177(4.137 to 10.719)	4.139(2.855 to 6.999)	– 1.218 (– 1.424 to – 1.011)
GBD regions:					
Andean Latin America	169.174(115.994 to 226.781)	301.278(223.06 to 400.081)	3.377(2.335 to 4.518)	1.948(1.444 to 2.582)	– 1.944 (– 2.224 to – 1.663)
Australasia	128.094(108.667 to 146.588)	290.102(230.458 to 341.001)	2.102(1.774 to 2.406)	1.68(1.341 to 1.977)	– 0.282 (– 0.697 to 0.135)
Caribbean	291.872(246.447 to 346.294)	402.357(325.334 to 495.958)	4.574(3.855 to 5.419)	2.687(2.174 to 3.314)	– 1.636 (– 2.098 to – 1.172)
Central Asia	187.047(164.015 to 212.844)	174.481(147.489 to 204.139)	1.578(1.381 to 1.796)	0.91(0.768 to 1.06)	– 1.839 (– 2.114 to – 1.562)
Central Europe	1667.76(1553.271 to 1765.287)	900.752(795.495 to 994.625)	4.701(4.331 to 4.993)	1.368(1.208 to 1.512)	– 4.243 (– 4.667 to – 3.816)
Central Latin America	1423.417(1319.073 to 1529.127)	2836.071(2445.069 to 3179.849)	7.651(7.05 to 8.233)	4.376(3.775 to 4.901)	– 1.632 (– 2.055 to – 1.207)
Central Sub-Saharan Africa	155.03(81.311 to 298.94)	356.582(165.824 to 683.231)	3.905(2.035 to 7.797)	3.543(1.635 to 7.001)	– 0.2 (– 0.244 to – 0.157)
East Asia	723.213(502.42 to 1013.836)	1157.19(872.246 to 1503.189)	0.516(0.369 to 0.729)	0.24(0.18 to 0.309)	– 2.723 (– 3.016 to – 2.428)

Table 4 (continued)

Variables	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Eastern Europe	1410.605(1327.557 to 1481.913)	1734.357(1546.474 to 1890.415)	2.017(1.882 to 2.124)	1.754(1.562 to 1.913)	– 1 (– 1.333 to – 0.665)
Eastern Sub-Saharan Africa	645.866(402.918 to 1444.582)	1243.585(777.764 to 2862.768)	4.358(2.698 to 9.962)	3.7(2.304 to 8.523)	– 0.508 (– 0.594 to – 0.423)
High-income Asia Pacific	465.268(407.191 to 505.814)	1136.773(825.106 to 1329.194)	0.99(0.852 to 1.081)	0.557(0.419 to 0.645)	– 1.023 (– 1.695 to – 0.347)
High-income North America	2196.976(1939.88 to 2356.689)	2689.454(2251.634 to 2954.661)	2.199(1.94 to 2.36)	1.357(1.148 to 1.486)	– 1.677 (– 2.228 to – 1.123)
North Africa and Middle East	302.201(208.073 to 455.03)	487.86(364.855 to 697.318)	0.855(0.584 to 1.307)	0.512(0.381 to 0.737)	– 1.513 (– 1.632 to – 1.393)
Oceania	4.848(2.57 to 12.874)	11.203(5.627 to 27.338)	0.871(0.488 to 2.179)	0.741(0.38 to 1.748)	– 0.111 (– 0.326 to 0.105)
South Asia	9276.271(6559.098 to 13,679.065)	11,233.956(8299.78 to 15,877.465)	7.75(5.414 to 11.481)	3.455(2.521 to 4.857)	– 2.786 (– 3.015 to – 2.556)
Southeast Asia	3073.122(1980.609 to 5184.403)	6368.152(4109.84 to 8298.059)	5.582(3.598 to 9.351)	4.276(2.829 to 5.529)	– 0.809 (– 0.883 to – 0.735)
Southern Latin America	437.618(385.12 to 489.236)	502.249(426.558 to 568.268)	3.82(3.345 to 4.275)	2.013(1.712 to 2.277)	– 1.272 (– 1.891 to – 0.65)
Southern Sub-Saharan Africa	177.153(120.32 to 282.188)	404.759(325.716 to 487.887)	2.84(1.928 to 4.485)	3.056(2.465 to 3.674)	0.587 (0.344 to 0.83)
Tropical Latin America	770.742(699.978 to 833.737)	2872.845(2496.152 to 3153.535)	3.724(3.341 to 4.045)	4.257(3.687 to 4.675)	0.975 (0.719 to 1.232)
Western Europe	4762.686(4276.408 to 5078.587)	5374.898(4434.903 to 5946.283)	2.916(2.605 to 3.116)	1.617(1.357 to 1.78)	– 1.865 (– 2.16 to – 1.568)
Western Sub-Saharan Africa	649.436(399.732 to 1590.732)	1355.013(840.551 to 3190.031)	3.59(2.199 to 8.812)	3.511(2.196 to 8.293)	0.05 (– 0.045 to 0.146)

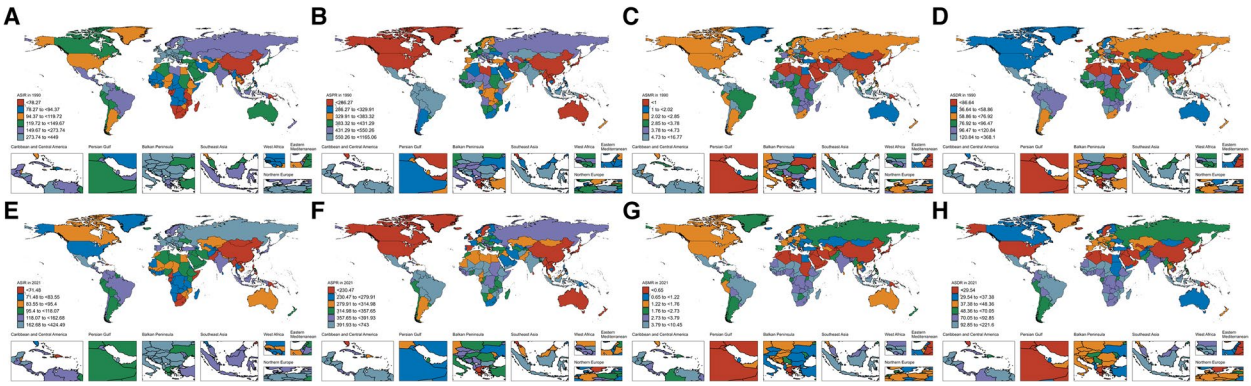

Fig. 5 Global distribution of age-standardized rates for inguinal, femoral, and abdominal hernia, 1990 and 2021. Global maps illustrating the distribution of age-standardized incidence rates (ASIR), prevalence rates (ASPR), mortality rates (ASMR), and DALY rates (ASDR) across 204 countries in (**A**-**D**) 1990 and (**E**–**H**) 2021

of aging to prevalence was 27.09% (Table 10). In terms of DALYs, the contribution of aging in the high-income Asia–Pacific region amounted to 83.29% (Table 11). In terms of mortality, Western Europe had the greatest impact of aging with a contribution of 274.18% (Table 12). In contrast, in some low-income regions, such as Central and Western sub-Saharan Africa, ageing has instead led to a slight decline in indicators. Despite the fact that population growth and aging have led to an increase in the burden of disease in most regions, epidemiologic changes have acted as a mitigating factor in most regions. For example, in the analysis of morbidity in the Western Europe region, epidemiologic changes led to a significant decrease of 590.26%.

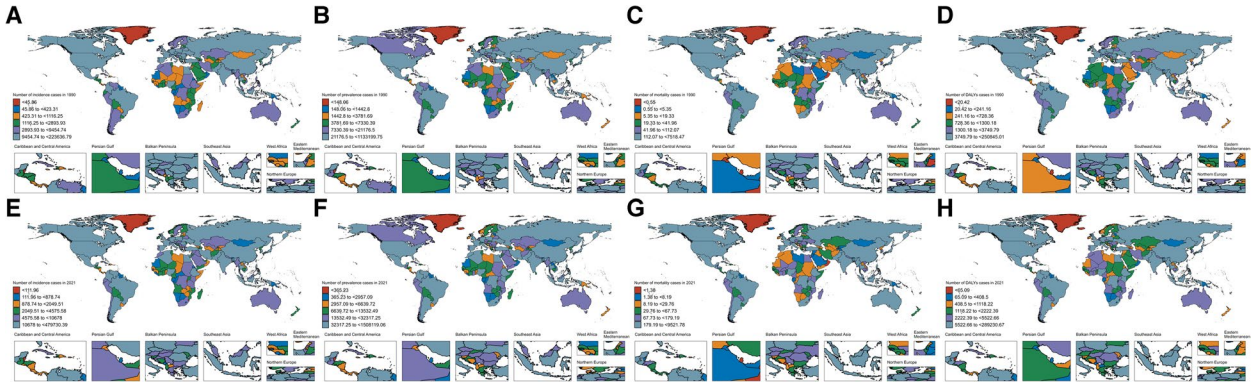

Fig. 6 Global distribution of absolute numbers for inguinal, femoral, and abdominal hernia burden, 1990 and 2021. Global maps depicting the distribution of absolute numbers of incident cases, prevalent cases, deaths, and DALYs across 204 countries in (**A**-**D**) 1990 and (**E**–**H**) 2021

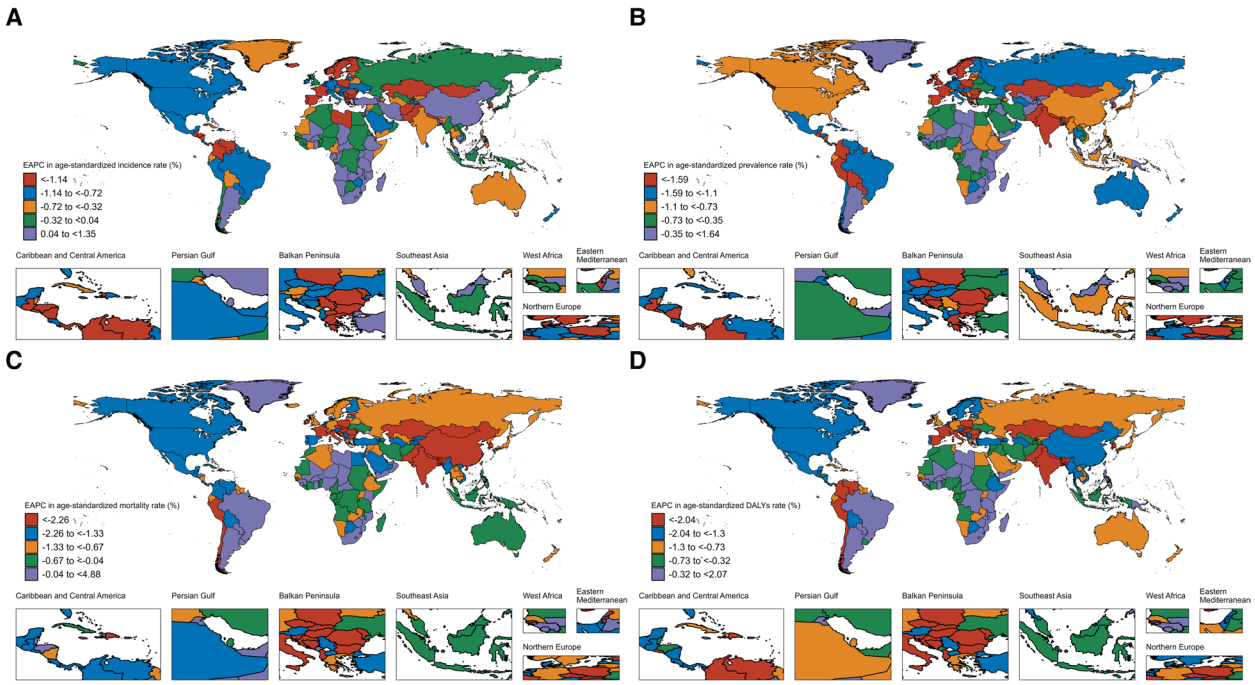

Fig. 7 Estimated annual percentage change (EAPC) in age-standardized rates by countries and sex, 1990–2021. World maps illustrating the EAPC in (**A**) age-standardized incidence rates, **B** prevalence rates, **C** mortality rates, and **D** DALY rates from 1990 to 2021 across 204 countries. Data are presented separately for both sexes combined, males, and females

Age-period-cohort analysis of inguinal, femoral and abdominal hernia epidemiology

The epidemiologic characteristics were complicated by age, period, and cohort effects (Fig. 9). In terms of incidence, the overall population showed an increasing and then decreasing trend with age, peaking in the 65–69 age group (RR = 1.43, 95% CI: 1.42–1.43). There were significant gender differences, with the female population showing a fluctuating upward trend, peaking in the 80–84 age group (RR = 1.35, 95% CI: 1.34–1.36), whereas the male population showed a similar trend to the overall trend, peaking in the 65–69 age group (RR = 1.47, 95% CI: 1.46–1.47). Analysis of time effects showed that incidence rates peaked in 2007–2011 in both the overall and male populations (overall: RR = 1.03, 95% CI: 1.03–1.04; male: RR = 1.03, 95% CI: 1.03–1.03), and in the female population during the same period (RR = 1.06, 95% CI: 1.06–1.06). In terms of cohort effects, incidence peaked in the 1927–1931 birth cohort for the overall population (RR = 1.13, 95% CI: 1.12–1.14), in the 1917–1921 birth cohort for the female population (RR = 1.21, 95% CI: 1.19–1.23), and

Table 5 Incidence of inguinal, femoral, and abdominal hernia in 204 countries and territories for population aged 45 years and above, 1990–2021

Location	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Afghanistan	2501.174(1434.357 to 4025.784)	2829.485(1612.535 to 4645.782)	118.48(68.037 to 190.514)	76.893(44.551 to 124.09)	− 1.305 (− 1.531 to − 1.078)
Albania	1943.886(1143.14 to 3057.772)	2276.634(1353.106 to 3550.853)	319.448(188.331 to 501.262)	199.21(117.728 to 311.969)	− 0.745 (− 1.084 to − 0.404)
Algeria	4848.593(2726.624 to 7915.594)	11,657.8(6607.068 to 19,032.254)	132.741(74.826 to 216.152)	106.171(60.48 to 172.688)	− 0.323 (− 0.543 to − 0.103)
American Samoa	5.811(3.586 to 8.866)	13.725(9.016 to 19.869)	87.645(54.207 to 133.444)	94.155(62.049 to 135.844)	0.908 (0.543 to 1.274)
Andorra	53.486(31.576 to 85.043)	77.07(46.465 to 119.917)	333.345(196.505 to 530.394)	182.071(109.864 to 283.103)	− 1.406 (− 1.671 to − 1.141)
Angola	927.331(546.288 to 1439.69)	2888.997(1810.135 to 4340.931)	78.323(46.24 to 120.972)	78.759(49.442 to 117.535)	0.342 (0.164 to 0.521)
Antigua and Barbuda	14.277(8.604 to 22.414)	29.828(18.201 to 45.259)	110.661(66.187 to 174.65)	93.532(57.336 to 141.499)	− 0.595 (− 0.666 to − 0.524)
Argentina	9184.759(5469.104 to 14,608.374)	14,523.55(9179.067 to 21,491.725)	102.56(60.977 to 163.314)	99.426(62.604 to 147.686)	0.356 (0.217 to 0.496)
Armenia	1102.15(682.829 to 1675.334)	1602.927(1047.226 to 2310.107)	134.579(83.183 to 204.824)	134.824(87.329 to 195.571)	0.631 (0.342 to 0.922)
Australia	6382.13(3984.258 to 9685.448)	10,609.011(6682.84 to 16,123.72)	121.749(75.481 to 186.02)	93.028(57.666 to 143.682)	− 0.716 (− 0.78 to − 0.652)
Austria	9895.509(5681.422 to 15,606.377)	10,118.951(6293.519 to 15,374.189)	339.892(194.774 to 540.292)	244.412(151.072 to 372.931)	− 0.721 (− 0.952 to − 0.489)
Azerbaijan	1622.704(948.264 to 2571.634)	2745.887(1660.423 to 4238.584)	105.397(61.538 to 166.929)	80.266(48.575 to 123.687)	− 0.357 (− 0.727 to 0.015)
Bahamas	60.243(36.293 to 94.101)	113.859(71.871 to 169.545)	135.63(82.161 to 210.752)	90.753(57.633 to 134.448)	− 1.008 (− 1.112 to − 0.903)
Bahrain	88.719(51.165 to 142.215)	485.074(281.188 to 790.189)	160.667(94.148 to 254.455)	125.863(74.538 to 201.041)	− 0.259 (− 0.457 to − 0.061)
Bangladesh	9437.743(5263.373 to 15,531.691)	34,172.831(19,385.076 to 56,246.27)	68.803(38.441 to 112.695)	84.259(47.9 to 138.33)	0.843 (0.68 to 1.006)
Barbados	82.531(50.898 to 127.232)	130.021(82.614 to 195.493)	121.742(74.517 to 189.752)	95.279(59.981 to 144.103)	− 0.716 (− 0.777 to − 0.654)
Belarus	9982.685(5924.666 to 15,624.577)	7613.425(4730.295 to 11,590.82)	280.161(166.597 to 438.967)	179.625(110.84 to 274.623)	− 0.641 (− 0.993 to − 0.287)
Belgium	12,927.599(7292.582 to 20,554.528)	10,285.55(6202.188 to 15,945.863)	335.245(188.893 to 534.622)	199.154(118.574 to 311.159)	− 0.989 (− 1.355 to − 0.62)
Belize	27.531(16.079 to 43.706)	80.265(49.989 to 121.355)	109.37(63.903 to 173.566)	88.214(55.44 to 132.257)	− 0.681 (− 0.725 to − 0.638)
Benin	453.51(271.874 to 700.591)	1164.69(729.367 to 1763.606)	81.483(48.876 to 125.773)	74.83(47.053 to 112.271)	− 0.086 (− 0.219 to 0.047)
Bermuda	25.645(16.172 to 38.366)	39.355(24.834 to 60.199)	147.083(92.794 to 219.899)	117.297(73.149 to 181.121)	− 0.706 (− 0.747 to − 0.665)
Bhutan	69.156(41.159 to 106.328)	149.302(92.284 to 227.029)	95.25(56.812 to 145.882)	88.135(54.609 to 133.491)	− 0.365 (− 0.426 to − 0.304)
Bolivia (Plurinational State of)	1246.947(732.016 to 1957.67)	2643.797(1653.045 to 3998.33)	133.273(78.117 to 209.161)	99.194(62.132 to 149.623)	− 0.666 (− 0.8 to − 0.532)
Bosnia and Herzegovina	3383.097(2177.474 to 5033.413)	3235.819(2016.124 to 4876.418)	275.231(177.576 to 410.031)	204.522(126.357 to 310.918)	− 0.82 (− 1.053 to − 0.587)
Botswana	111.956(66.502 to 171.814)	299.605(191.426 to 453.005)	66.984(39.851 to 102.534)	65.662(42.104 to 98.33)	− 0.23 (− 0.307 to − 0.153)
Brazil	47,639.74(29,015.423 to 72,041.389)	87,178.658(54,600.262 to 130,553.813)	181.967(111.056 to 274.48)	123.269(77.245 to 184.446)	− 1.08 (− 1.233 to − 0.928)

Table 5 (continued)

Location	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Brunei Darussalam	45.859(26.201 to 74.937)	136.472(78.051 to 221.278)	145.028(82.903 to 236.586)	118.073(68.119 to 189.513)	– 2.1 (– 2.599 to – 1.599)
Bulgaria	15,331.654(9510.856 to 23,122.715)	7429.244(4641.267 to 11,166.82)	433.317(267.556 to 656.891)	212.345(131.891 to 319.933)	– 2.522 (– 2.637 to – 2.406)
Burkina Faso	1120.325(688.145 to 1700.702)	2572.083(1615.522 to 3851.101)	88.29(54.179 to 133.888)	94.471(59.356 to 140.881)	0.464 (0.324 to 0.605)
Burundi	522.318(308.227 to 814.528)	1319.129(809.916 to 2012.344)	80.313(47.432 to 125.006)	89.459(54.947 to 135.997)	0.664 (0.455 to 0.875)
Cabo Verde	40.932(24.757 to 62.351)	112.64(71.615 to 169.606)	69.875(42.227 to 106.622)	87.109(55.539 to 130.552)	0.819 (0.683 to 0.956)
Cambodia	1240.432(736.857 to 1947.501)	3143.725(2046.992 to 4610.457)	95.008(56.569 to 148.7)	85.298(55.489 to 124.72)	0.067 (– 0.125 to 0.26)
Cameroon	1151.054(693.204 to 1774.885)	2643.852(1663.349 to 4013.649)	86.63(52.106 to 133.197)	68.308(43.168 to 102.864)	– 0.55 (– 0.683 to – 0.417)
Canada	11,509.835(6855.674 to 18,020.201)	15,526.678(10,128.203 to 22,965.52)	131.99(78.071 to 207.877)	83.745(53.578 to 125.705)	– 0.839 (– 1.107 to – 0.569)
Central African Republic	288.118(169.9 to 453.57)	573.852(353.241 to 864.684)	81.492(47.976 to 127.803)	78.057(48.106 to 116.907)	0.087 (– 0.021 to 0.195)
Chad	640.619(385.922 to 995.965)	1559.958(972.242 to 2340.26)	80.786(48.635 to 125.494)	89.014(55.624 to 132.694)	0.508 (0.376 to 0.639)
Chile	3918.845(2520.101 to 5776.117)	9476.194(6289.071 to 13,705.535)	139.12(89.671 to 204.52)	135.901(90.019 to 196.885)	– 0.047 (– 0.114 to 0.019)
China	119,904.85(68,303.436 to 193,922.583)	397,651.893(231,271.935 to 638,422.346)	48.609(27.781 to 78.322)	64.157(37.517 to 102.55)	1.135 (0.951 to 1.32)
Colombia	14,396.558(8657.858 to 22,103.53)	21,082.569(13,599.952 to 30,792.323)	284.265(171.462 to 435.413)	139.471(90.014 to 203.778)	– 1.634 (– 2.008 to – 1.259)
Comoros	54.35(32.047 to 84.798)	116.003(73.087 to 175.802)	92.83(54.74 to 144.853)	80.374(50.639 to 121.381)	– 0.257 (– 0.393 to – 0.12)
Congo	221.968(132.749 to 341.685)	609.327(388.44 to 913.386)	70.835(42.401 to 108.739)	71.575(45.979 to 105.938)	0.319 (0.187 to 0.452)
Cook Islands	4.744(2.976 to 7.098)	7.716(5.12 to 11.082)	128.534(80.667 to 191.795)	106.188(70.144 to 152.953)	– 0.67 (– 0.781 to – 0.56)
Costa Rica	1017.106(587.199 to 1622.163)	2032.183(1287.011 to 3038.609)	211.365(122.296 to 336.484)	135.195(85.668 to 202.142)	– 0.954 (– 1.176 to – 0.731)
Coted'Ivoire	1205.53(716.206 to 1882.559)	2934.352(1863.924 to 4405.157)	96.412(57.513 to 149.839)	83.166(52.934 to 123.463)	– 0.374 (– 0.526 to – 0.221)
Croatia	5960.371(3709.606 to 9260.301)	4801.023(3197.594 to 6836.153)	340.122(211.714 to 528.373)	222.824(147.358 to 318.563)	– 0.799 (– 1.074 to – 0.524)
Cuba	4760.458(2990.386 to 7224.299)	7096.125(4584.433 to 10,574.989)	170.932(107.294 to 259.633)	133.736(86.407 to 199.435)	– 0.54 (– 0.638 to – 0.442)
Cyprus	610.255(357.46 to 960.712)	895.534(539.581 to 1394.626)	265.696(154.793 to 420.18)	168.394(100.559 to 264.336)	– 1.353 (– 1.492 to – 1.213)
Czechia	13,109.238(7775.493 to 20,332.03)	11,111.817(6894.488 to 16,846.667)	360.474(212.76 to 563.037)	220.136(134.88 to 337.37)	– 1.019 (– 1.301 to – 0.736)
Democratic People's Republic of Korea	1995.914(1139.22 to 3246.105)	3676.461(2173.344 to 5841.939)	39.955(23.058 to 64.389)	38.002(22.616 to 60.179)	0.032 (– 0.128 to 0.192)
Democratic Republic of the Congo	3957.527(2344.443 to 6125.635)	8633.449(5526.924 to 12,888.124)	85.645(50.744 to 132.05)	74.845(47.882 to 110.858)	– 0.053 (– 0.354 to 0.249)
Denmark	5952.662(3564.715 to 9332.388)	4509.252(2822.886 to 6822.79)	297.418(176.663 to 469.852)	161.915(99.321 to 249.001)	– 1.33 (– 1.663 to – 0.996)
Djibouti	37.556(21.883 to 59.994)	174.308(108.041 to 262.958)	87.545(51.206 to 138.893)	85.506(53.255 to 128.127)	0.096 (– 0.061 to 0.254)

Table 5 (continued)

Location	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Dominica	14.964(8.956 to 23.42)	18.406(11.348 to 28.217)	98.351(58.66 to 154.273)	76.642(47.285 to 117.435)	− 0.504 (− 0.624 to − 0.384)
Dominican Republic	1013.692(582.336 to 1646.673)	1990.779(1166.674 to 3168.883)	94.104(54.195 to 152.214)	69.933(41.077 to 111.118)	− 0.844 (− 1.015 to − 0.673)
Ecuador	2169.808(1332.048 to 3325.334)	4928.179(3218.655 to 7258.892)	144.773(89.214 to 220.872)	108.101(70.685 to 159.009)	− 0.325 (− 0.525 to − 0.124)
Egypt	9539.744(5358.42 to 15,439.166)	19,965.916(11,479.364 to 32,456.444)	110.351(62.3 to 178.102)	94.999(55.128 to 152.939)	− 0.131 (− 0.43 to 0.168)
El Salvador	2063.676(1250.555 to 3166.61)	2011.634(1291.66 to 2970.074)	250.785(152.239 to 383.916)	121.636(78.125 to 179.676)	− 1.847 (− 2.116 to − 1.578)
Equatorial Guinea	36.171(21.505 to 55.576)	108.536(67.256 to 164.226)	61.57(36.557 to 94.176)	71.763(44.794 to 107.481)	1.018 (0.78 to 1.256)
Eritrea	271.701(161.96 to 426.613)	685.926(420.096 to 1040.35)	73.395(43.654 to 114.639)	77.499(47.433 to 117.129)	0.011 (− 0.065 to 0.086)
Estonia	1329.463(770.006 to 2137.463)	947.73(571.617 to 1479.831)	239.406(138.591 to 385.914)	159.553(94.798 to 252.568)	− 0.611 (− 0.914 to − 0.308)
Eswatini	50.528(29.966 to 77.88)	90.857(57.752 to 136.399)	57.587(34.331 to 88.327)	53.228(33.962 to 79.232)	− 0.078 (− 0.143 to − 0.014)
Ethiopia	5732.298(3360.97 to 8930.873)	12,402.989(7403.992 to 19,029.542)	94.677(55.378 to 147.584)	99.02(59.214 to 151.603)	0.163 (0.037 to 0.29)
Fiji	64.473(38.89 to 100.927)	145.507(94.005 to 216.481)	59.883(36.365 to 93.144)	61.755(39.942 to 91.45)	0.52 (0.375 to 0.664)
Finland	5577.739(3370.5 to 8667.953)	4561.124(2899.455 to 6885.57)	304.596(183.197 to 476.128)	171.132(106.256 to 263.283)	− 1.255 (− 1.641 to − 0.867)
France	73,779.559(44,576.729 to 112,202.058)	53,741.397(33,004.401 to 83,638.901)	355.567(214.007 to 546.166)	176.787(106.643 to 279.107)	− 1.575 (− 1.872 to − 1.277)
Gabon	115.403(67.757 to 178.158)	219.505(138.938 to 324.226)	70.946(41.656 to 109.446)	67.926(43.178 to 99.705)	0.199 (0.066 to 0.331)
Gambia	110.144(67.029 to 169.903)	231.781(147.9 to 344.098)	106.866(65.195 to 163.877)	80.985(51.837 to 119.219)	− 0.939 (− 1.031 to − 0.846)
Georgia	1964.345(1137.878 to 3143.295)	1988.52(1325.889 to 2817.641)	108.96(63.212 to 174.392)	126.179(83.474 to 180.008)	1.348 (0.775 to 1.923)
Germany	108,932.733(65,203.934 to 171,020.992)	83,003.29(50,050.367 to 130,605.704)	335.037(199.91 to 528.374)	199.591(119.128 to 318.302)	− 0.953 (− 1.255 to − 0.651)
Ghana	1520.696(914.041 to 2370.839)	4168.206(2677.284 to 6165.686)	81.293(48.962 to 126.232)	81.462(52.564 to 119.75)	0.191 (0.062 to 0.321)
Greece	10,782.698(6410.271 to 16,817.196)	5904.416(3745.269 to 8743.395)	263.562(156.156 to 412.775)	114.642(72.122 to 171.09)	− 2.227 (− 2.749 to − 1.702)
Greenland	10.768(6.304 to 17.195)	17.193(11.067 to 25.184)	98.115(58.145 to 154.792)	80.565(52.192 to 117.242)	− 0.429 (− 0.601 to − 0.256)
Grenada	18.651(11.351 to 28.462)	37.384(23.916 to 55.49)	110.01(66.492 to 169.082)	108.361(69.76 to 160.064)	− 0.059 (− 0.116 to − 0.003)
Guam	16.817(10.489 to 25.476)	32.598(20.422 to 49.347)	74.852(47.298 to 112.201)	55.358(34.72 to 83.785)	− 0.998 (− 1.165 to − 0.831)
Guatemala	2784.456(1692.872 to 4276.679)	4224.588(2756.96 to 6191.809)	268.836(164.03 to 411.634)	136.607(89.418 to 199.404)	− 1.706 (− 1.94 to − 1.472)
Guinea	761.93(449.055 to 1206.793)	1198.426(754.061 to 1785.265)	81.221(47.799 to 128.6)	73.343(46.269 to 108.738)	− 0.11 (− 0.235 to 0.014)
Guinea-Bissau	109.523(64.423 to 172.005)	180.825(112.104 to 271.292)	93.581(55.066 to 146.651)	79.823(49.585 to 119.261)	− 0.36 (− 0.469 to − 0.251)
Guyana	146.699(91.385 to 217.948)	203.426(130.056 to 304.942)	132.851(82.978 to 196.822)	103.138(66.107 to 153.998)	− 0.751 (− 0.848 to − 0.654)
Haiti	1468.609(849.508 to 2335.848)	2066.828(1245.724 to 3178.264)	149.647(86.45 to 237.754)	93.088(56.256 to 142.377)	− 1.256 (− 1.368 to − 1.143)

Table 5 (continued)

Location	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Honduras	1612.862(970.224 to 2500.238)	3040.913(1936.549 to 4479.334)	277.311(166.93 to 428.928)	166.576(106.319 to 244.243)	− 1.242 (− 1.455 to − 1.028)
Hungary	12,902.613(7813.64 to 19,781.049)	9632.882(6141.379 to 14,227.682)	323.407(194.707 to 499.468)	205.167(129.029 to 307.174)	− 0.805 (− 1.083 to − 0.526)
Iceland	162.445(95.642 to 257.5)	165.783(94.784 to 280.641)	223.076(130.502 to 355.362)	117.775(66.908 to 200.723)	− 2.358 (− 2.708 to − 2.006)
India	223,636.79(133,013.43 to 347,927.557)	479,730.395(284,571.062 to 752,719.651)	161.945(96.512 to 251.191)	140.324(83.445 to 219.389)	− 0.704 (− 0.86 to − 0.548)
Indonesia	44,131.217(26,272.394 to 67,913.025)	104,139.096(67,239.182 to 151,256.114)	151.632(90.284 to 233.422)	144.364(93.147 to 209.197)	− 0.285 (− 0.484 to − 0.086)
Iran (Islamic Republic of)	7147.325(3976.528 to 11,801.015)	23,333.21(13,206.066 to 37,990.465)	85.971(47.927 to 141.632)	98.38(55.901 to 159.709)	0.634 (0.518 to 0.75)
Iraq	2768.357(1569.954 to 4564.856)	8528.828(4843.612 to 14,143.275)	122.464(69.576 to 201.84)	106.233(60.907 to 174.59)	− 0.032 (− 0.313 to 0.249)
Ireland	3002.817(1807.647 to 4696.126)	3477.684(2121.768 to 5355.899)	281.262(168.476 to 442.534)	173.831(105.048 to 269.656)	− 1.071 (− 1.343 to − 0.798)
Israel	3432.008(2062.539 to 5306.456)	4604.485(2762.456 to 7230.377)	273.441(163.486 to 425.527)	153.245(91.237 to 242.197)	− 1.588 (− 1.832 to − 1.344)
Italy	68,163.387(41,134.337 to 105,877.396)	70,066.944(42,776.948 to 107,593.932)	295.282(176.971 to 462.33)	214.051(129.468 to 331.836)	− 1.049 (− 1.246 to − 0.851)
Jamaica	525.499(314.827 to 827.536)	862.646(547.612 to 1292.2)	118.067(70.537 to 186.487)	101.735(64.599 to 152.44)	− 0.134 (− 0.256 to − 0.011)
Japan	68,047.856(39,445.334 to 108,823.888)	113,084.736(67,384.211 to 179,236.805)	143.899(83.467 to 230.034)	152.373(89.346 to 245.307)	− 0.017 (− 0.184 to 0.149)
Jordan	588.776(332.867 to 962.705)	3062.629(1772.856 to 4813.476)	138.01(78.523 to 225.2)	120.45(70.318 to 188.491)	0.273 (− 0.057 to 0.604)
Kazakhstan	5632.265(3602.493 to 8299.2)	5045.71(3110.984 to 7726.489)	149.704(95.603 to 220.853)	91.558(56.452 to 139.964)	− 1.557 (− 1.75 to − 1.364)
Kenya	2461.327(1430.158 to 3895.379)	8131.874(4946.517 to 12,353.614)	103.921(60.35 to 164.468)	116.1(70.796 to 175.768)	0.564 (0.473 to 0.655)
Kiribati	7.713(4.588 to 12.01)	11.995(7.379 to 18.044)	69.937(41.576 to 108.965)	53.271(32.858 to 79.769)	− 0.758 (− 0.872 to − 0.645)
Kuwait	362.9(211.608 to 586.638)	1380.673(793.704 to 2222.345)	192.293(113.64 to 306.687)	130.735(76.818 to 206.754)	− 0.704 (− 0.906 to − 0.502)
Kyrgyzstan	1001.011(588.221 to 1601.194)	1359.87(786.201 to 2188.939)	117.515(68.915 to 188.577)	86.543(50.298 to 138.496)	− 0.618 (− 0.965 to − 0.269)
Lao People's Democratic Republic	478.891(280.542 to 750.712)	945.844(596.412 to 1410.479)	78.889(46.289 to 123.387)	68.878(43.527 to 102.213)	− 0.301 (− 0.548 to − 0.054)
Latvia	2531.409(1499.34 to 3983.469)	1250.534(742.691 to 1949.319)	258.805(153.264 to 407.914)	140.524(82.459 to 221.572)	− 1.878 (− 2.265 to − 1.489)
Lebanon	882.994(492.723 to 1453.335)	1771.824(1010.875 to 2897.616)	133.476(74.746 to 219.331)	115.943(66.018 to 189.844)	0.221 (0.014 to 0.429)
Lesotho	132.489(79.832 to 202.619)	186.025(118.769 to 275.363)	54.713(33.004 to 83.473)	58.656(37.523 to 86.527)	0.279 (0.219 to 0.339)
Liberia	342.819(201.318 to 538.109)	560.715(347.75 to 854.513)	106.009(62.179 to 166.436)	87.744(54.682 to 131.913)	− 0.149 (− 0.365 to 0.068)
Libya	837.981(473.058 to 1385.207)	1721.288(972.768 to 2798.595)	149.874(84.943 to 246.836)	97.165(55.362 to 156.483)	− 1.163 (− 1.421 to − 0.904)
Lithuania	3411.228(1989.495 to 5436.53)	2223.253(1376.695 to 3327.498)	275.562(160.527 to 440.143)	166.492(101.73 to 251.301)	− 0.759 (− 1.125 to − 0.392)
Luxembourg	492.79(288.63 to 769.517)	574.033(342.319 to 894.697)	343.809(200.387 to 539.373)	211.619(125.841 to 330.871)	− 1.12 (− 1.456 to − 0.782)

Table 5 (continued)

Location	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Madagascar	1112.166(650.09 to 1759.5)	2703.265(1660.375 to 4126.204)	76.483(44.75 to 120.639)	76.252(47.081 to 115.822)	0.189 (0.026 to 0.351)
Malawi	850.04(500.109 to 1341.125)	1749.427(1095.17 to 2612.925)	76.522(45.053 to 120.5)	80.264(50.42 to 119.465)	0.343 (0.208 to 0.478)
Malaysia	3460.876(2150.219 to 5233.178)	10,129.863(6753.889 to 14,392.373)	134.483(83.606 to 202.767)	126.028(84.052 to 178.679)	0.234 (0.091 to 0.378)
Maldives	34.567(20.612 to 53.868)	91.593(57.345 to 137.661)	132.532(79.555 to 205.17)	93.94(59.869 to 138.579)	− 1.065 (− 1.258 to − 0.872)
Mali	950.946(558.697 to 1494.305)	2290.974(1428.764 to 3407.578)	79.837(46.98 to 125.109)	85.988(53.64 to 127.527)	0.37 (0.275 to 0.465)
Malta	361.706(215.17 to 566.817)	374.369(231.011 to 572.926)	310.953(184.761 to 488.283)	178.089(107.552 to 277.971)	− 1.23 (− 1.588 to − 0.87)
Marshall Islands	3.56(2.154 to 5.447)	6.898(4.374 to 10.374)	78.053(47.168 to 119.352)	63.896(40.68 to 95.598)	− 0.535 (− 0.62 to − 0.45)
Mauritania	257.857(152.02 to 411.081)	492.056(308.538 to 734.77)	90.431(53.355 to 143.766)	78.085(49.108 to 115.984)	− 0.354 (− 0.487 to − 0.22)
Mauritius	144.013(84.105 to 232.486)	268.379(159.313 to 425.806)	68.668(40.268 to 110.511)	50.729(30.179 to 80.282)	− 1.115 (− 1.424 to − 0.805)
Mexico	32,461.627(19,843.743 to 48,676.139)	61,228.883(38,604.61 to 91,538.872)	264.587(162.426 to 395.746)	167.432(105.994 to 249.352)	− 0.965 (− 1.248 to − 0.681)
Micronesia (Federated States of)	10.34(6.205 to 16.066)	14.277(9.011 to 21.426)	76.137(45.584 to 118.526)	60.86(38.62 to 90.806)	− 0.504 (− 0.72 to − 0.288)
Monaco	45.835(27.387 to 70.296)	33.797(20.199 to 53.228)	282.274(166.684 to 438.836)	157.694(92.625 to 252.784)	− 1.309 (− 1.607 to − 1.01)
Mongolia	456.104(277.801 to 695.039)	567.515(326.919 to 914.084)	151.342(92.139 to 230.347)	70.984(41.264 to 113.604)	− 2.664 (− 2.917 to − 2.411)
Montenegro	485.459(275.199 to 788.01)	489.054(287.08 to 774.879)	270.991(154.044 to 439.157)	188.252(110.05 to 298.759)	− 0.538 (− 0.867 to − 0.207)
Morocco	4836.972(2711.286 to 7905.708)	9849.603(5706.535 to 15,857.37)	118.1(66.265 to 192.761)	94.842(55.218 to 152.032)	− 0.381 (− 0.617 to − 0.144)
Mozambique	1256.292(746.819 to 1957.6)	2986.971(1867.595 to 4440.821)	71.003(42.212 to 110.494)	87.945(54.908 to 130.198)	0.914 (0.802 to 1.027)
Myanmar	5446.926(3220.178 to 8543.508)	10,314.122(6641.989 to 15,062.573)	79.804(47.145 to 125.051)	69.325(44.7 to 100.991)	0.013 (− 0.283 to 0.309)
Namibia	142.493(85.65 to 217.999)	305.725(192.59 to 466.863)	74.043(44.605 to 112.986)	72.483(45.847 to 109.731)	0.11 (0.035 to 0.185)
Nauru	1.07(0.622 to 1.681)	0.8(0.494 to 1.223)	77.47(45.12 to 121.203)	43.31(26.831 to 65.912)	− 1.601 (− 1.924 to − 1.278)
Nepal	3773.939(2241.517 to 5773.58)	6055.241(3825.191 to 9000.676)	135.789(80.633 to 207.356)	91.427(57.903 to 135.427)	− 1.498 (− 1.616 to − 1.38)
Netherlands	15,618.122(9290.467 to 24,505.053)	15,249.306(9419.857 to 23,231.088)	305.62(180.694 to 482.753)	182.585(111.294 to 281.594)	− 1.061 (− 1.305 to − 0.817)
New Zealand	1621.988(978.054 to 2523.85)	2531.935(1548.015 to 3889.338)	155.806(93.471 to 243.703)	115.745(70.18 to 179.153)	− 0.761 (− 0.967 to − 0.556)
Nicaragua	1178.294(715.737 to 1828.698)	1826.576(1178.048 to 2711.462)	272.008(165.928 to 420.001)	129.634(84.108 to 190.934)	− 1.73 (− 2.028 to − 1.431)
Niger	824.427(483.653 to 1282.145)	2130.742(1315.96 to 3180.294)	97.612(57.266 to 151.399)	84.94(52.335 to 126.421)	− 0.072 (− 0.268 to 0.125)
Nigeria	14,716.176(8520.739 to 23,497.285)	29,513.363(17,514.716 to 45,769.401)	111.441(64.56 to 177.812)	103.978(61.965 to 160.352)	0.036 (− 0.09 to 0.162)
Niue	0.386(0.241 to 0.584)	0.368(0.234 to 0.547)	67.347(42.159 to 101.94)	59.106(37.549 to 87.92)	− 0.281 (− 0.351 to − 0.211)
North Macedonia	1738.297(1047.127 to 2730.095)	1784.65(1102.902 to 2747.73)	321.641(194.112 to 504.392)	192.317(118.518 to 296.41)	− 1.235 (− 1.533 to − 0.936)

Table 5 (continued)

Location	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Northern Mariana Islands	3.695(2.104 to 6.002)	8.068(4.745 to 12.989)	66.965(38.868 to 107.131)	46.723(27.862 to 74.229)	− 1.008 (− 1.199 to − 0.816)
Norway	3659.195(2218.783 to 5687.555)	3774.335(2263.279 to 5925.103)	222.412(132.749 to 351.333)	155.724(92.31 to 247.08)	− 2.105 (− 2.842 to − 1.362)
Oman	320.297(179.006 to 525.031)	880.153(496.405 to 1462.447)	148.267(83.278 to 241.464)	115.362(65.6 to 188.721)	− 0.297 (− 0.496 to − 0.097)
Pakistan	19,458.296(11,400.911 to 30,384.873)	23,937.165(14,018.033 to 38,123.248)	120.889(70.924 to 188.512)	63.456(37.419 to 100.03)	− 2.287 (− 2.401 to − 2.172)
Palau	2.176(1.353 to 3.281)	4.734(2.992 to 7.111)	78.018(48.371 to 117.673)	65.349(41.639 to 97.286)	− 0.516 (− 0.614 to − 0.418)
Palestine	296.395(167.38 to 480.743)	968.026(544.484 to 1574.144)	118.544(67.106 to 191.827)	114.049(64.821 to 183.738)	0.355 (0.19 to 0.52)
Panama	848.577(492.017 to 1345.861)	1498.182(913.096 to 2301.636)	203.194(118.179 to 321.157)	122.886(74.999 to 188.622)	− 1.379 (− 1.541 to − 1.217)
Papua New Guinea	323.966(188.279 to 514.692)	865.214(521.386 to 1346.528)	58.131(33.825 to 92.185)	52.97(31.969 to 81.915)	− 0.236 (− 0.286 to − 0.187)
Paraguay	1095.382(670.878 to 1658.853)	2112.649(1340.224 to 3112.289)	175.414(107.57 to 264.989)	128.177(81.396 to 188.466)	− 0.975 (− 1.087 to − 0.863)
Peru	4970.72(2991.101 to 7632.798)	9819.058(6013.582 to 15,102.524)	144.595(87.216 to 221.286)	104.112(63.992 to 159.62)	− 0.744 (− 0.942 to − 0.545)
Philippines	6973.828(4105.325 to 10,865.537)	17,281.903(10,724.243 to 26,099.553)	79.579(47.012 to 123.717)	70.016(43.631 to 105.197)	− 0.582 (− 0.79 to − 0.374)
Poland	37,950.188(23,774.061 to 56,497.231)	29,566.183(17,845.34 to 46,085.44)	317.398(197.693 to 475.038)	169.7(101.344 to 267.378)	− 2.072 (− 2.298 to − 1.845)
Portugal	11,358.893(6885.777 to 17,450.826)	9515.748(6070.755 to 13,882.691)	300.222(181.135 to 463.878)	174.081(109.594 to 256.642)	− 1.419 (− 1.667 to − 1.171)
Puerto Rico	1104.87(670.275 to 1698.69)	1359.431(840.427 to 2106.306)	113.495(68.678 to 174.877)	87.03(52.963 to 136.751)	− 0.836 (− 0.871 to − 0.801)
Qatar	84.215(47.388 to 139.688)	747.216(427.672 to 1213.019)	182.181(103.154 to 299.381)	169.083(99.523 to 267.94)	0.445 (0.25 to 0.641)
Republic of Korea	17,973.755(10,926.059 to 27,752.504)	32,378.622(18,825.876 to 51,362.704)	197.725(121.066 to 303.727)	125.423(72.996 to 199.427)	− 1.583 (− 1.992 to − 1.173)
Republic of Moldova	4244.276(2601.981 to 6491.819)	2257.005(1402.25 to 3421.692)	332.211(203.483 to 508.267)	143.734(88.874 to 218.463)	− 2.545 (− 2.8 to − 2.289)
Romania	26,754.787(16,235.778 to 41,118.988)	17,345.27(10,699.333 to 26,614.903)	335.36(203.229 to 516.734)	190.946(117.208 to 294.12)	− 1.156 (− 1.489 to − 0.822)
Russian Federation	99,459.643(59,024.891 to 155,536.389)	115,717.976(69,835.253 to 180,011.658)	197.853(117.143 to 310.353)	181.553(109.016 to 283.239)	− 0.076 (− 0.217 to 0.065)
Rwanda	681.079(407.724 to 1051.961)	1638.391(1012.506 to 2451.39)	82.916(49.573 to 128.375)	86.241(53.326 to 128.683)	0.316 (0.099 to 0.533)
Saint Kitts and Nevis	13.066(8.074 to 19.593)	21.249(13.491 to 31.519)	146.626(89.945 to 220.418)	95.517(60.841 to 141.16)	− 1.411 (− 1.596 to − 1.226)
Saint Lucia	26.28(15.614 to 40.798)	59.638(36.939 to 91.423)	112.246(66.654 to 174.622)	86.595(53.728 to 132.557)	− 0.703 (− 0.778 to − 0.628)
Saint Vincent and the Grenadines	21.894(13.515 to 33.317)	45.727(29.89 to 66.305)	117.378(72.27 to 179.078)	112.707(73.611 to 163.525)	− 0.05 (− 0.119 to 0.018)
Samoa	17.827(10.883 to 27.379)	28.107(17.875 to 42.281)	71.735(43.811 to 110.135)	66.307(42.327 to 99.32)	0.051 (− 0.106 to 0.209)
San Marino	23.414(13.429 to 37.979)	25.448(14.866 to 40.414)	267.287(152.398 to 436.244)	152.593(88.345 to 244.161)	− 1.362 (− 1.788 to − 0.935)
Sao Tome and Principe	14.327(8.644 to 22.072)	26.229(16.359 to 39.721)	78.317(47.269 to 120.667)	76.727(48.029 to 115.037)	0.142 (0.009 to 0.276)

Table 5 (continued)

Location	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Saudi Arabia	2623.21(1492.409 to 4284.205)	8129.577(4574.074 to 13,393.469)	146.05(83.748 to 236.771)	107.891(61.867 to 175.065)	– 0.825 (– 1.022 to – 0.628)
Senegal	861.517(515.605 to 1330.885)	1947.088(1228.45 to 2925.262)	92.714(55.53 to 142.807)	84.618(53.452 to 126.368)	– 0.167 (– 0.284 to – 0.049)
Serbia	11,051.441(6610.244 to 17,370.436)	8623.699(5579.271 to 12,668.532)	327.462(195.579 to 512.888)	208.507(132.749 to 311.451)	– 1.199 (– 1.552 to – 0.845)
Seychelles	12.201(7.378 to 18.751)	21.585(13.529 to 32.275)	80.6(48.628 to 124.034)	61.848(38.998 to 91.918)	– 1.124 (– 1.31 to – 0.937)
Sierra Leone	503.32(294.26 to 800.02)	875.913(556.319 to 1310.387)	88.211(51.537 to 140.091)	78.004(49.692 to 116.029)	– 0.075 (– 0.34 to 0.191)
Singapore	1005.603(589.731 to 1598)	2954.686(1749.554 to 4617.338)	152.509(89.892 to 241.184)	122.881(72.888 to 191.629)	– 0.723 (– 1.09 to – 0.355)
Slovakia	4911.213(2924.247 to 7694.565)	4871.806(3014.968 to 7399.419)	307.404(182.823 to 482.627)	201.422(123.541 to 307.66)	– 0.738 (– 0.993 to – 0.481)
Slovenia	2321.33(1396.634 to 3655.684)	2676.318(1682.926 to 4044.668)	345.815(207.606 to 546.261)	257.35(159.475 to 393.848)	– 0.446 (– 0.648 to – 0.243)
Solomon Islands	28.494(16.914 to 44.707)	57.49(35.156 to 87.635)	67.939(40.272 to 106.382)	53.549(33.002 to 80.733)	– 0.634 (– 0.772 to – 0.496)
Somalia	600.187(356.78 to 943.335)	1194.015(734.476 to 1810.64)	81.214(48.36 to 127.091)	64.167(39.526 to 96.628)	– 0.57 (– 0.706 to – 0.435)
South Africa	3724.174(2174.137 to 5862.392)	8445.095(5217.77 to 12,751.844)	62.756(36.767 to 98.43)	62.058(38.513 to 93.234)	0.307 (0.203 to 0.412)
South Sudan	672.757(391.587 to 1063.604)	905.761(557.232 to 1387.715)	93.419(54.511 to 147.255)	76.272(47.076 to 115.974)	– 0.331 (– 0.517 to – 0.145)
Spain	46,742.189(28,647.424 to 71,284.473)	31,887.643(20,845.825 to 46,540.306)	318.519(194.148 to 488.49)	135.971(87.681 to 200.385)	– 2.015 (– 2.415 to – 1.615)
Sri Lanka	3441.792(2082.397 to 5255.692)	5714.07(3630.12 to 8595.031)	114.127(69.311 to 173.519)	74.777(47.48 to 112.443)	– 0.993 (– 1.196 to – 0.789)
Sudan	3305.421(1863.982 to 5401.598)	6107.517(3498.054 to 9907.229)	121.448(68.549 to 197.99)	99.289(57.318 to 159.409)	– 0.308 (– 0.591 to – 0.025)
Suriname	109.45(66.481 to 168.254)	190.355(121.614 to 286.646)	145.271(88.286 to 223.059)	102.429(65.551 to 153.927)	– 0.912 (– 0.977 to – 0.846)
Sweden	7262.368(4356.928 to 11,535.278)	6122.031(3680.755 to 9503.93)	199.844(118.34 to 319.854)	123.609(73.121 to 195.407)	– 1.51 (– 1.785 to – 1.235)
Switzerland	8223.433(4807.95 to 13,152.303)	8598.127(5137.32 to 13,595.991)	322.535(187.24 to 519.028)	209.604(123.576 to 335.006)	– 0.903 (– 1.235 to – 0.57)
Syrian Arab Republic	2216.94(1258.768 to 3667.026)	4801.894(2733.835 to 7840.983)	141.437(80.631 to 233.103)	110.261(63.261 to 179.029)	– 0.434 (– 0.644 to – 0.224)
Taiwan (Province of China)	3888.678(2489.899 to 5764.531)	6928.109(4237.176 to 10,697.032)	85.31(54.919 to 125.84)	59.75(36.467 to 92.277)	– 1.751 (– 1.973 to – 1.528)
Tajikistan	893.003(492.635 to 1482.174)	1578.671(881.943 to 2617.772)	110.875(61.366 to 183.812)	78.991(44.476 to 129.889)	– 0.863 (– 1.272 to – 0.452)
Thailand	11,514.687(6942.152 to 17,626.51)	23,977.266(15,487.388 to 34,862.947)	108.974(65.897 to 166.78)	77.941(50.331 to 113.339)	– 0.575 (– 0.798 to – 0.352)
Timor-Leste	81.385(46.949 to 131.544)	204.569(126.757 to 309.21)	96.307(55.809 to 153.879)	84.11(52.096 to 127.026)	– 0.131 (– 0.379 to 0.118)
Togo	320.426(192.051 to 508.488)	1021.156(642.189 to 1535.794)	87.157(52.281 to 137.15)	82.123(51.753 to 122.767)	0.012 (– 0.164 to 0.189)
Tokelau	0.241(0.147 to 0.373)	0.23(0.144 to 0.346)	63.147(38.325 to 97.887)	56.375(35.226 to 85.014)	– 0.195 (– 0.398 to 0.007)
Tonga	14.004(8.584 to 21.375)	17.561(11.407 to 25.601)	86.013(52.684 to 131.239)	77.945(50.73 to 113.383)	– 0.219 (– 0.321 to – 0.117)
Trinidad and Tobago	353.137(220.321 to 527.548)	612.767(398.797 to 895.546)	152.117(95.123 to 226.753)	114.743(74.481 to 168.263)	– 0.65 (– 0.759 to – 0.541)

Table 5 (continued)

Location	Incidence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Tunisia	1950.735(1087.078 to 3200.139)	4457.14(2538.372 to 7148.86)	131.214(73.308 to 214.69)	114.473(65.311 to 183.28)	0.035 (– 0.132 to 0.201)
Turkey	13,945.04(8010.801 to 22,453.662)	34,106.043(20,221.624 to 53,929.996)	136.716(78.845 to 219.506)	125.254(74.381 to 197.562)	0.413 (0.202 to 0.624)
Turkmenistan	633.034(384.725 to 975.051)	1093.965(681.371 to 1669.075)	111.008(67.288 to 171.114)	85.393(53.3 to 129.816)	– 0.588 (– 0.808 to – 0.367)
Tuvalu	1.326(0.807 to 2.021)	1.897(1.203 to 2.84)	64.982(39.387 to 99.203)	61.963(39.238 to 92.628)	– 0.096 (– 0.184 to – 0.007)
Uganda	1383.528(838.282 to 2113.482)	3496.375(2219.546 to 5261.18)	74.719(45.287 to 113.893)	78.917(50.105 to 118.623)	0.269 (0.166 to 0.372)
Ukraine	28,650.999(16,017.411 to 46,768.681)	20,787.406(11,897.109 to 33,722.857)	146.501(81.906 to 239.706)	107.182(61.13 to 174.328)	– 0.768 (– 0.996 to – 0.539)
United Arab Emirates	263.697(147.729 to 435.63)	2764.904(1547.115 to 4616.58)	151.036(85.826 to 247.833)	113.635(65.266 to 184.393)	– 1.011 (– 1.256 to – 0.764)
United Kingdom	101,802.467(61,215.814 to 157,888.05)	132,865.074(79,569.554 to 205,339.045)	449.002(267.684 to 703.211)	424.491(252.471 to 661.808)	– 0.074 (– 1.587 to 1.462)
United Republic of Tanzania	2285.3(1368.186 to 3615.847)	5879.959(3705.556 to 8858.345)	72.452(43.429 to 114.377)	77.744(49.145 to 116.38)	0.447 (0.344 to 0.55)
United States of America	78,232.982(46,896.146 to 122,273.504)	109,360.045(66,146.87 to 169,629.856)	94.507(56.168 to 149.052)	73.35(43.932 to 114.564)	– 0.825 (– 1.086 to – 0.564)
United States Virgin Islands	27.759(16.731 to 43.785)	42.546(27.235 to 63.263)	105.717(64.098 to 165.931)	92.921(58.789 to 140.192)	– 0.255 (– 0.386 to – 0.124)
Uruguay	1256.89(805.437 to 1846.526)	1584.395(1018.569 to 2330.483)	121.404(77.204 to 179.448)	118.065(75.162 to 175.132)	0.003 (– 0.088 to 0.094)
Uzbekistan	2839.48(1598.773 to 4666.431)	6160.973(3628.315 to 9687.452)	85.139(47.92 to 139.943)	72.781(43.146 to 113.663)	– 0.015 (– 0.268 to 0.239)
Vanuatu	15.859(9.386 to 24.61)	35.338(22.26 to 53.286)	85.119(50.329 to 131.924)	66.685(42.099 to 99.92)	– 0.718 (– 0.776 to – 0.661)
Venezuela (Bolivarian Republic of)	6798.945(4038.008 to 10,727.501)	11,022.941(7005.567 to 16,528.345)	248.068(147.714 to 391.18)	127.473(81.053 to 190.825)	– 1.346 (– 1.667 to – 1.023)
Viet Nam	8682.057(5026.971 to 13,822.034)	20,433.933(12,695.1 to 30,696.145)	77.884(45.149 to 123.889)	67.523(42.171 to 100.915)	– 0.165 (– 0.343 to 0.015)
Yemen	1980.191(1129.378 to 3214.991)	4436.371(2568 to 7157.395)	130.785(74.7 to 212.252)	100.018(58.334 to 160.316)	– 0.521 (– 0.766 to – 0.276)
Zambia	671.348(398.102 to 1051.768)	1676.064(1077.141 to 2524.46)	80.871(47.9 to 126.394)	78.898(50.867 to 117.846)	0.061 (– 0.074 to 0.197)
Zimbabwe	1293.755(802.839 to 1938.127)	1847.905(1161.368 to 2762.862)	108.635(67.706 to 162.044)	89.046(56.242 to 131.748)	– 0.954 (– 1.16 to – 0.748)

in the male population in the 1922–1926 birth cohort (RR = 1.13, 95% CI: 1.12–1.15) (Fig. 9A).

Prevalence analysis showed that the overall population was highest in the 70–74 years age group (RR = 1.25, 95% CI: 1.24–1.25). Gender differences were also evident, with the female population reaching its highest in the 85–89 age group (RR = 1.13, 95% CI: 1.12–1.13), while the male population reached its highest in the 65–69 age group (RR = 1.27, 95% CI: 1.27–1.28). Analysis of time effects showed that prevalence peaked in 1992–1996 for the overall population, female population and male population (overall: RR = 1.17, 95% CI: 1.17–1.17; female: RR = 1.16, 95% CI: 1.16–1.16; male: RR = 1.17, 95% CI: 1.17–1.17). Analysis of cohort effects showed that the prevalence in the overall population peaked in the 1927–1931 birth cohort (RR = 1.05, 95% CI: 1.05–1.05), whereas in both the female and male populations it peaked in the 1907–1911 birth cohort (female: RR = 1.14, 95% CI: 1.13–1.16; male: RR = 1.14, 95% CI: 1.12–1.15) (Fig. 9B).

In terms of DALYs, they continued to rise with age. In the overall population, the burden of DALYs in the 95–99

Table 6 Prevalence of inguinal, femoral, and abdominal hernia in 204 countries and territories for population aged 45 years and above, 1990–2021

Location	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Afghanistan	8227.633(5000.297 to 12,513.016)	16,314.164(10,501.048 to 24,133.587)	387.434(236.245 to 588.157)	402.418(262.154 to 586.519)	– 0.231 (– 0.475 to 0.013)
Albania	3263.925(2149.088 to 4745.619)	4294.832(2704.917 to 6521.513)	548.923(366.155 to 790.695)	377.618(236.872 to 576.314)	– 1.502 (– 1.612 to – 1.392)
Algeria	12,074.761(6960.956 to 18,993.11)	34,564.937(21,012.695 to 53,218.898)	329.305(190.855 to 516.562)	311.012(189.729 to 476.844)	– 0.511 (– 0.728 to – 0.294)
American Samoa	18.462(12.908 to 25.682)	48.408(35.692 to 64.352)	293.653(207.92 to 402.518)	343.651(255.072 to 453.731)	0.956 (0.613 to 1.299)
Andorra	47.511(29.507 to 72.79)	107.394(68.365 to 162.334)	300.468(186.616 to 459.931)	251.914(160.331 to 380.914)	– 1.016 (– 1.176 to – 0.855)
Angola	5351.322(3822.87 to 7320.088)	14,182.777(10,369.472 to 19,034.535)	467.499(334.931 to 634.442)	399.503(294.087 to 529.983)	– 0.651 (– 0.688 to – 0.614)
Antigua and Barbuda	52.971(35.842 to 74.92)	97.975(65.735 to 140.001)	409.831(274.027 to 585.115)	307.505(207.832 to 436.849)	– 1.113 (– 1.161 to – 1.064)
Argentina	27,678.748(18,582.426 to 39,266.267)	43,277.257(30,424.688 to 60,061.079)	310.714(208.339 to 441.571)	294.561(205.55 to 411.347)	– 0.131 (– 0.213 to – 0.049)
Armenia	3425.508(2336.646 to 4805.965)	4534.76(3267.338 to 6104.677)	446.359(308.428 to 619.217)	388.149(278.386 to 525.478)	– 0.415 (– 0.485 to – 0.345)
Australia	13,566.601(9082.03 to 19,651.715)	19,126.717(12,805.562 to 27,872.955)	259.032(171.948 to 378.408)	165.064(107.843 to 245.531)	– 1.44 (– 1.541 to – 1.338)
Austria	14,745.962(10,403.704 to 20,137.946)	15,438.763(10,212.552 to 22,696.565)	502.77(350.196 to 693.53)	371.059(243.371 to 549.842)	– 1.216 (– 1.406 to – 1.026)
Azerbaijan	4898.433(3119.579 to 7108.477)	8947.734(5778.834 to 13,053.057)	324.893(208.49 to 470.148)	266.66(173.394 to 387.227)	– 0.959 (– 1.143 to – 0.774)
Bahamas	217.452(151.024 to 303.943)	422.522(297.075 to 583.863)	486.11(340.523 to 672.198)	336.25(238.375 to 461.355)	– 1.261 (– 1.333 to – 1.19)
Bahrain	197.176(117.595 to 304.721)	1129.888(673.374 to 1800.306)	351.561(219.675 to 527.294)	284.919(173.927 to 443.61)	– 1.034 (– 1.164 to – 0.904)
Bangladesh	49,285.037(30,384.378 to 73,641.113)	136,523.405(83,670.356 to 209,112.275)	355.022(220.821 to 527.123)	336.464(206.741 to 513.581)	– 0.462 (– 0.636 to – 0.287)
Barbados	276.429(192.402 to 379.305)	420.587(294.149 to 583.364)	404.349(276.07 to 564.083)	311.443(215.845 to 436.019)	– 1.03 (– 1.079 to – 0.98)
Belarus	13,846.794(9034.459 to 20,118.418)	14,623.615(9794.941 to 21,186.489)	393.372(257.061 to 572.271)	344.835(229.389 to 502.741)	– 0.642 (– 0.791 to – 0.493)
Belgium	16,355.012(10,793.878 to 23,727.304)	15,834.255(10,081.509 to 23,940.554)	423.726(273.712 to 627.12)	303.688(190.227 to 467.506)	– 1.166 (– 1.576 to – 0.754)
Belize	108.895(73.093 to 153.757)	310.314(218.72 to 430.44)	432.278(290.499 to 609.626)	337.876(240.764 to 462.967)	– 1.03 (– 1.087 to – 0.973)
Benin	2262.926(1608.438 to 3060.363)	5385.826(3976.021 to 7161.111)	409.915(292.098 to 553.15)	350.031(260.053 to 461.758)	– 0.647 (– 0.69 to – 0.604)
Bermuda	78.514(54.781 to 110.424)	89.71(60.486 to 128.765)	451.936(315.845 to 634.644)	268.968(178.544 to 391.586)	– 1.855 (– 1.941 to – 1.769)
Bhutan	406.163(288.628 to 551.556)	561.853(386.953 to 792.818)	571.401(407.667 to 771.818)	332.797(230.155 to 466.968)	– 1.984 (– 2.049 to – 1.919)
Bolivia (Plurinational State of)	6761.454(4884.788 to 9040.444)	11,833.642(8528.008 to 15,942.084)	722.906(523.065 to 964.918)	444.656(321.599 to 596.648)	– 1.643 (– 1.688 to – 1.598)
Bosnia and Herzegovina	9409.731(6932.547 to 12,704.644)	6091.26(4065.889 to 8831.24)	802.766(599.804 to 1069.99)	383.838(253.219 to 563.552)	– 2.639 (– 2.725 to – 2.552)
Botswana	692.75(499.781 to 935.173)	1398.51(1031.218 to 1863.116)	417.342(302.115 to 561.185)	308.071(228.825 to 406.868)	– 1.362 (– 1.485 to – 1.239)
Brazil	196,492.478(145,013.977 to 259,978.391)	327,949.778(242,530.767 to 435,664.329)	763.145(566.727 to 1003.506)	465.909(345.148 to 617.931)	– 1.476 (– 1.656 to – 1.294)

Table 6 (continued)

Location	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Brunei Darussalam	56.237(31.827 to 91.866)	184.15(108.547 to 295.305)	184.26(105.805 to 296.469)	162.713(98.064 to 255.796)	− 0.482 (− 0.593 to − 0.372)
Bulgaria	32,760.846(24,754.379 to 42,547.61)	15,039.51(10,220.639 to 21,366.719)	932.025(699.709 to 1218.751)	425.474(286.995 to 610.546)	− 3.408 (− 3.709 to − 3.106)
Burkina Faso	5749.405(4142.691 to 7748.106)	12,407.011(9123.713 to 16,519.103)	465.161(336.57 to 623.972)	465.498(343.478 to 616.936)	0.033 (− 0.032 to 0.098)
Burundi	2288.799(1594.284 to 3157.685)	6582.949(4760.126 to 8906.062)	352.735(245.777 to 486.426)	452.23(327.42 to 609.827)	0.797 (0.758 to 0.837)
Cabo Verde	192.473(136.323 to 261.16)	376.217(266.687 to 515.241)	327.127(230.993 to 446.161)	292.982(208.514 to 399.77)	− 0.57 (− 0.68 to − 0.46)
Cambodia	3767.218(2613.68 to 5203.175)	9414.094(6881.447 to 12,516.472)	297.072(207.187 to 408.449)	261.609(192.143 to 346.249)	− 0.492 (− 0.534 to − 0.45)
Cameroon	4813.553(3364.093 to 6574.938)	11,670.497(8462.031 to 15,869.095)	372.044(260.831 to 506.372)	306.396(224.307 to 411.625)	− 0.878 (− 0.981 to − 0.775)
Canada	12,777.219(8586.934 to 18,406.267)	21,843.909(15,043.443 to 31,126.222)	145.919(96.889 to 212.306)	117.334(78.803 to 170.897)	− 0.781 (− 0.835 to − 0.726)
Central African Republic	1712.594(1216.242 to 2327.824)	3672.619(2749.206 to 4844.937)	498.59(355.897 to 673.261)	517.388(389.252 to 676.865)	0.054 (0.021 to 0.088)
Chad	3796.162(2727.062 to 5067.99)	8430.82(6180.58 to 11,261.3)	483.53(347.719 to 644.469)	486.437(358.538 to 644.874)	− 0.083 (− 0.185 to 0.019)
Chile	14,830.563(10,949.916 to 19,988.576)	24,094.116(17,701.33 to 32,107.619)	531.855(394.727 to 712.597)	345.464(253.145 to 461.592)	− 1.488 (− 1.577 to − 1.399)
China	401,910.119(242,059.147 to 615,838.455)	804,706.459(482,796.303 to 1,240,761.775)	166.232(101.403 to 252.462)	130.664(78.949 to 200.747)	− 0.918 (− 1.037 to − 0.799)
Colombia	42,964.106(31,109.621 to 57,768.65)	64,489.031(45,930.011 to 89,208.825)	852.696(624.818 to 1135.993)	426.701(304.043 to 590.517)	− 2.23 (− 2.369 to − 2.091)
Comoros	229.165(156.279 to 321.584)	518.916(370.686 to 712.837)	396.021(270.549 to 553.854)	364.329(261.018 to 498.46)	− 0.389 (− 0.429 to − 0.348)
Congo	1113.326(797.669 to 1514.084)	2811.918(2059.527 to 3802.945)	365.395(262.39 to 494.661)	340.361(252.817 to 451.348)	− 0.402 (− 0.47 to − 0.334)
Cook Islands	17.734(12.604 to 24.235)	20.828(14.962 to 28.17)	494.084(352.827 to 671.085)	287.08(205.775 to 389.718)	− 1.693 (− 1.855 to − 1.531)
Costa Rica	2648.535(1759.826 to 3850.812)	5686.318(3946.26 to 8011.09)	548.168(366.496 to 791.934)	378.321(262.644 to 533.296)	− 1.313 (− 1.346 to − 1.28)
Coted'Ivoire	5158.257(3582.137 to 7110.681)	12,879.54(9523.212 to 17,062.685)	423.624(296.234 to 579.397)	371.156(276.725 to 486.622)	− 0.673 (− 0.748 to − 0.598)
Croatia	11,296.875(8033.19 to 15,521.093)	7727.481(5785.861 to 10,185.079)	658.96(470.837 to 901.747)	351.362(259.83 to 468.792)	− 1.92 (− 2.087 to − 1.754)
Cuba	14,812.551(10,329.648 to 20,581.533)	20,276.068(14,405.89 to 27,888.788)	529.132(368.334 to 736.481)	382.725(271.262 to 528.204)	− 1.24 (− 1.3 to − 1.18)
Cyprus	637.875(391.575 to 979.299)	1321.513(833.622 to 2031.176)	287.255(174.94 to 442.87)	249.471(155.381 to 387.355)	− 0.724 (− 0.795 to − 0.653)
Czechia	21,904.314(15,543.527 to 30,129.96)	18,287.224(11,966.461 to 27,223.47)	597.262(418.825 to 829.254)	359.471(230.421 to 545.015)	− 1.753 (− 1.862 to − 1.644)
Democratic People's Republic of Korea	6038.441(3611.753 to 9219.523)	11,611.05(7353.478 to 17,284.419)	123.092(75.067 to 185.322)	120.362(76.78 to 178.311)	− 0.31 (− 0.404 to − 0.217)
Democratic Republic of the Congo	16,852.908(11,877.478 to 22,905.99)	43,887.476(32,676.386 to 58,255.141)	378.966(267.648 to 513.653)	390.725(292.636 to 513.993)	0.02 (− 0.017 to 0.058)
Denmark	6399.58(4237.387 to 9319.087)	6624.364(4484.706 to 9643.222)	313.876(202.24 to 467.205)	235.054(154.273 to 352.109)	− 1.401 (− 1.66 to − 1.142)
Djibouti	151.107(101.261 to 213.726)	719.874(506.834 to 997.122)	360.214(243.291 to 505.769)	358.738(254.061 to 492.102)	− 0.159 (− 0.232 to − 0.085)

Table 6 (continued)

Location	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Dominica	62.286(42.958 to 86.576)	71.441(49.044 to 100.292)	409.151(280.076 to 572.591)	300.779(206.665 to 422.104)	− 1.04 (− 1.114 to − 0.967)
Dominican Republic	4583.1(3010.808 to 6569.193)	8187.318(5344.355 to 11,940.179)	421.381(278.186 to 601.638)	285.962(187.003 to 416.105)	− 1.521 (− 1.667 to − 1.376)
Ecuador	8457.384(6149.439 to 11,240.804)	17,634.392(13,190.27 to 23,137.299)	563.294(411.741 to 745.066)	387.46(290.268 to 507.497)	− 1.081 (− 1.186 to − 0.977)
Egypt	29,068.182(16,842.936 to 45,070.26)	62,655.326(38,377.491 to 96,900.647)	324.062(189.706 to 499.232)	295.151(182.288 to 452.091)	− 0.453 (− 0.578 to − 0.329)
El Salvador	6922.604(5039.185 to 9271.937)	6912.567(5013.088 to 9454.883)	840.818(614.131 to 1122.006)	415.967(301.383 to 569.458)	− 2.391 (− 2.549 to − 2.233)
Equatorial Guinea	267.084(196.645 to 352.851)	434.576(308.257 to 601.389)	466.491(344.985 to 612.844)	296.17(212.444 to 403.012)	− 1.847 (− 2.035 to − 1.659)
Eritrea	1458.974(1041.262 to 1992.926)	3467.539(2479.627 to 4711.138)	407.374(290.999 to 552.226)	397.976(284.343 to 538.688)	− 0.184 (− 0.242 to − 0.126)
Estonia	1773.155(1098.847 to 2680.894)	1652.141(1050.643 to 2496.388)	320.037(197.91 to 485.547)	274.458(171.068 to 421.098)	− 0.836 (− 0.983 to − 0.689)
Eswatini	270.478(194.232 to 367.448)	454.965(333.421 to 603.141)	310.492(224.054 to 418.504)	268.609(198.29 to 353.326)	− 0.404 (− 0.482 to − 0.326)
Ethiopia	35,209.267(24,949.016 to 47,860.765)	59,069.961(40,847.582 to 81,801.929)	598.237(424.773 to 809.546)	480.374(333.549 to 661.662)	− 0.839 (− 0.885 to − 0.793)
Fiji	265.679(184.837 to 370.641)	548.22(394.022 to 746.314)	255.567(180.569 to 349.987)	239.84(173.965 to 323.372)	0.208 (0.058 to 0.357)
Finland	6159.498(4066.158 to 8926.496)	6698.176(4532.487 to 9767.689)	333.2(216.783 to 488.783)	247.363(162.239 to 372.415)	− 1.399 (− 1.57 to − 1.227)
France	86,959.835(60,222.007 to 122,563.942)	79,823.984(52,185.306 to 119,274.413)	408.609(276.868 to 588.433)	256.468(163.095 to 393.568)	− 1.789 (− 1.855 to − 1.723)
Gabon	502.332(349.874 to 694.856)	896.943(650.019 to 1217.176)	313.622(218.682 to 433.12)	284.861(208.364 to 381.951)	− 0.414 (− 0.468 to − 0.361)
Gambia	472.817(334.934 to 647.798)	1047.752(777.382 to 1393.026)	466.298(332.343 to 634.799)	369.015(275.461 to 486.294)	− 1.144 (− 1.248 to − 1.04)
Georgia	4325.741(2664.046 to 6527.056)	5895.626(4441.425 to 7674.604)	246.181(152.546 to 370.851)	373.685(279.477 to 489.436)	1.638 (1.479 to 1.797)
Germany	131,669.664(87,500.976 to 192,563.924)	125,114.255(79,223.112 to 191,478.676)	402.433(263.612 to 596.998)	298.186(184.764 to 465.784)	− 1.118 (− 1.325 to − 0.91)
Ghana	7423.864(5204.755 to 10,305.093)	17,783.265(13,122.48 to 23,477.876)	406.917(286.834 to 560.587)	355.142(263.838 to 464.966)	− 0.429 (− 0.481 to − 0.377)
Greece	10,125.48(6431.773 to 15,082.681)	8370.946(5758.331 to 11,845.121)	248.443(156.669 to 373.207)	157.919(106.776 to 226.557)	− 1.619 (− 1.849 to − 1.388)
Greenland	14.66(9.001 to 22.496)	36.242(25.273 to 51.011)	135.928(86.077 to 203.456)	171.248(120.514 to 239.525)	1.118 (0.999 to 1.238)
Grenada	82.868(59.465 to 112.264)	133.885(96.053 to 182.796)	493.675(350.256 to 675.696)	387.591(280.069 to 526.368)	− 0.916 (− 0.989 to − 0.843)
Guam	49.806(33.983 to 71.07)	92.006(62.328 to 130.758)	235.017(164.357 to 327.768)	157.99(107.453 to 224.158)	− 1.371 (− 1.574 to − 1.168)
Guatemala	11,471.308(8743.324 to 14,715.753)	18,479.069(14,050.479 to 23,895.158)	1111.341(850.3 to 1420.091)	596.059(455.042 to 767.517)	− 2.174 (− 2.277 to − 2.071)
Guinea	3762.73(2622.312 to 5149.711)	6126.569(4544.754 to 8117.106)	407.12(284.495 to 555.902)	378.242(281.728 to 498.358)	− 0.248 (− 0.346 to − 0.15)
Guinea-Bissau	620.558(442.925 to 837.718)	993.315(732.17 to 1317.698)	540.82(387.54 to 727.444)	446.489(330.259 to 588.881)	− 0.651 (− 0.68 to − 0.621)
Guyana	837.124(637.215 to 1086.544)	954.955(719.845 to 1253.981)	759.433(580.664 to 981.14)	484.891(366.859 to 633.825)	− 1.306 (− 1.441 to − 1.171)

Table 6 (continued)

Location	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Haiti	8389.078(5889.902 to 11,385.167)	13,324.374(9711.158 to 17,869.334)	857.971(602.246 to 1163.641)	593.52(432.693 to 794.589)	− 1.3 (− 1.339 to − 1.262)
Honduras	6723.98(4876.105 to 9018.94)	13,453.197(10,008.204 to 17,732.293)	1165.065(846.664 to 1558.33)	743.002(555.134 to 973.958)	− 1.493 (− 1.577 to − 1.408)
Hungary	21,581.065(15,442.525 to 29,655.023)	17,023.523(11,897.731 to 23,892.642)	540.97(383.377 to 749.342)	357.182(243.522 to 511.197)	− 1.431 (− 1.491 to − 1.371)
Iceland	132.81(83.73 to 200.445)	197.341(118.876 to 308.781)	179.918(111.427 to 275.288)	138.979(82.918 to 219.463)	− 1.251 (− 1.595 to − 0.906)
India	1,133,199.751(818,976.78 to 1,509,014.509)	1,508,119.062(1,020,883.083 to 2,099,638.734)	846.295(617.073 to 1118.746)	448.276(305.824 to 620.865)	− 2.325 (− 2.425 to − 2.226)
Indonesia	207,933.543(146,628.026 to 284,856.405)	400,175.981(298,409.996 to 525,468.82)	751.609(532.28 to 1024.675)	587.96(441.252 to 766.461)	− 0.892 (− 1.046 to − 0.736)
Iran (Islamic Republic of)	22,632.709(12,864.734 to 35,473.517)	58,275.871(33,627.437 to 92,045.095)	275.142(157.864 to 429.122)	244.405(142.169 to 383.48)	− 0.449 (− 0.502 to − 0.396)
Iraq	6799.244(3877.859 to 10,723.166)	25,667.805(15,628.766 to 40,068.204)	292.088(167.441 to 459.101)	309.933(189.789 to 479.726)	− 0.192 (− 0.446 to 0.063)
Ireland	3668.088(2461.698 to 5316.617)	4700.362(3015.742 to 7048.614)	342.982(225.814 to 505.845)	233.645(147.899 to 354.516)	− 1.667 (− 1.829 to − 1.505)
Israel	3855.884(2552.633 to 5632.896)	7001.995(4400.798 to 10,708.129)	311.109(202.813 to 461.096)	230.943(143.206 to 357.405)	− 1.224 (− 1.334 to − 1.113)
Italy	123,093.351(82,338.922 to 174,672.028)	110,886.406(73,320.253 to 158,005.793)	528.344(347.471 to 761.498)	329.81(214.458 to 476.138)	− 1.579 (− 1.628 to − 1.529)
Jamaica	1855.642(1240.807 to 2660.456)	3040.002(2169.155 to 4185.101)	417.978(278.243 to 602.18)	358.573(255.899 to 493.668)	− 0.403 (− 0.472 to − 0.334)
Japan	108,048.462(65,065.433 to 167,542.433)	146,236.503(92,784.648 to 217,139.621)	231.053(139.755 to 357.265)	188.715(114.886 to 288.402)	− 0.953 (− 1.131 to − 0.775)
Jordan	1447.777(830.528 to 2259.99)	8056.135(5099.799 to 11,987.566)	323.28(189.07 to 500.115)	308.669(196.724 to 457.014)	− 0.452 (− 0.599 to − 0.305)
Kazakhstan	22,401.387(16,873.852 to 29,116.191)	15,478.511(10,481.944 to 22,219.037)	617.315(466.842 to 799.866)	285.712(194.693 to 407.711)	− 2.924 (− 3.323 to − 2.524)
Kenya	11,824.648(7918.191 to 16,735.656)	36,237.679(25,693.361 to 49,240.847)	511.527(343.465 to 721.328)	532.771(379.718 to 719.399)	0.389 (0.317 to 0.46)
Kiribati	40.624(28.718 to 55.242)	62.67(45.628 to 84.096)	379.213(268.787 to 513.463)	286.645(210.14 to 381.31)	− 0.882 (− 0.989 to − 0.775)
Kuwait	710.135(426.386 to 1105.105)	2995.594(1826.82 to 4687.017)	366.328(229.101 to 550.196)	269.573(168.431 to 413.3)	− 1.272 (− 1.341 to − 1.202)
Kyrgyzstan	3142.507(2045.481 to 4527.75)	5642.565(3697.597 to 8252.762)	378.157(246.739 to 544.325)	359.565(237.372 to 521.902)	− 0.132 (− 0.368 to 0.103)
Lao People's Democratic Republic	1413.649(950.156 to 2001.835)	2885.549(2010.747 to 3998.283)	238.331(160.738 to 336.003)	213.025(149.639 to 292.091)	− 0.447 (− 0.492 to − 0.403)
Latvia	3478.214(2285.785 to 5083.327)	2406.073(1521.68 to 3614.455)	357.934(235.46 to 523.341)	266.527(165.399 to 406.388)	− 1.634 (− 1.85 to − 1.418)
Lebanon	2040.345(1151.389 to 3262.496)	4622.041(2820.766 to 7182.862)	306.528(174.243 to 488.228)	300.563(182.9 to 468.056)	− 0.458 (− 0.658 to − 0.258)
Lesotho	874.049(634.494 to 1160.395)	1070.935(813.67 to 1388.875)	361.882(263.222 to 479.527)	339.658(258.507 to 439.263)	− 0.204 (− 0.288 to − 0.12)
Liberia	1279.282(846.633 to 1814.45)	2458.44(1762.472 to 3344.748)	406.308(269.375 to 575.486)	390.552(282.193 to 526.465)	− 0.512 (− 0.635 to − 0.388)
Libya	1601.504(908.019 to 2547.813)	5538.524(3400.598 to 8470.213)	279.61(159.83 to 442.926)	299.341(184.616 to 452.989)	− 0.051 (− 0.194 to 0.091)
Lithuania	5209.432(3431.355 to 7527.262)	4424.786(3012.058 to 6375.919)	422.4(278.58 to 610.507)	325.887(217.212 to 477.786)	− 1.092 (− 1.29 to − 0.894)

Table 6 (continued)

Location	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Luxembourg	658.376(444.411 to 942.518)	852.966(532.612 to 1319.805)	458.634(305.64 to 663.69)	313.134(194.514 to 487.318)	− 1.643 (− 2.008 to − 1.276)
Madagascar	4730.226(3169.841 to 6721.089)	12,482.855(8861.516 to 16,997.834)	327.807(219.98 to 464.555)	356.212(253.665 to 481.537)	0.12 (0.087 to 0.153)
Malawi	3709.146(2556.772 to 5160.896)	7951.691(5786.415 to 10,711.322)	336.779(232.627 to 467.267)	367.508(268.257 to 492.588)	0.125 (0.083 to 0.168)
Malaysia	7886.783(5636.9 to 10,720.28)	22,992.239(17,127.691 to 30,367.894)	318.986(229.998 to 429.872)	295.723(221.407 to 388.566)	− 0.294 (− 0.401 to − 0.186)
Maldives	70.444(46.88 to 100.839)	192.238(128.642 to 280.021)	293.048(198.263 to 413.594)	201.428(139.041 to 284.817)	− 1.468 (− 1.538 to − 1.398)
Mali	5118.456(3623.701 to 6968.489)	10,967.983(7956.007 to 14,730.821)	441.835(313.937 to 598.351)	419.659(306.227 to 560.061)	− 0.259 (− 0.295 to − 0.223)
Malta	495.141(335.867 to 705.932)	568.9(368.426 to 842.637)	428.104(289.245 to 612.621)	267.657(167.887 to 406.279)	− 1.727 (− 1.963 to − 1.489)
Marshall Islands	17.33(12.299 to 23.626)	30.547(21.962 to 41.195)	388.06(276.473 to 526.212)	295.718(215.217 to 393.771)	− 0.816 (− 0.862 to − 0.77)
Mauritania	1136.48(788.147 to 1577.357)	1942.504(1386.671 to 2649.32)	405.088(281.599 to 560.953)	313.146(225.373 to 423.347)	− 1.094 (− 1.162 to − 1.027)
Mauritius	242.481(149.661 to 367.734)	570.399(350.24 to 884.756)	117.549(73.529 to 176.616)	108.612(67.007 to 168.114)	− 0.461 (− 0.558 to − 0.363)
Mexico	132,544.229(98,367.159 to 173,963.095)	231,837.994(171,836.285 to 305,579.159)	1102.896(826.495 to 1433.871)	638.981(476.444 to 837.021)	− 1.398 (− 1.709 to − 1.087)
Micronesia (Federated States of)	48.514(34.368 to 66.179)	59.442(42.816 to 80.948)	362.637(257.381 to 493.689)	261.792(190.26 to 352.611)	− 0.981 (− 1.187 to − 0.774)
Monaco	48.118(31.364 to 70.216)	49.216(31.54 to 75.031)	282.034(177.042 to 424.142)	224.661(139.942 to 351.954)	− 1.069 (− 1.177 to − 0.961)
Mongolia	2232.875(1637.3 to 2956.896)	2246.312(1439.443 to 3323.725)	751.711(552.087 to 992.794)	281.496(182.432 to 411.47)	− 3.801 (− 4.007 to − 3.595)
Montenegro	574.202(330.474 to 920.439)	834.465(508.177 to 1312.154)	322.186(186.925 to 515.79)	320.866(195.033 to 506.436)	− 0.521 (− 0.811 to − 0.23)
Morocco	14,934.453(8662.522 to 23,098.412)	33,241.495(20,741.918 to 50,700.164)	358.693(208.958 to 553.297)	318.941(199.931 to 484.385)	− 0.607 (− 0.755 to − 0.458)
Mozambique	6888.773(4864.364 to 9439.681)	14,563.436(10,578.164 to 19,497.676)	393.529(278.014 to 537.407)	433.071(315.257 to 577.307)	0.354 (0.304 to 0.405)
Myanmar	17,272.093(11,912.506 to 23,903.692)	30,350.251(21,914.683 to 41,041.932)	256.106(176.792 to 354.146)	205.242(148.717 to 276.342)	− 0.9 (− 1.019 to − 0.782)
Namibia	790.961(571.9 to 1064.486)	1417.256(1041.681 to 1889.969)	414.284(300.474 to 555.861)	339.369(251.301 to 448.663)	− 0.787 (− 0.872 to − 0.701)
Nauru	3.597(2.43 to 5.096)	3.391(2.384 to 4.672)	267.378(182.638 to 375.44)	186.271(132.178 to 253.968)	− 1.219 (− 1.324 to − 1.113)
Nepal	23,084.113(16,973.219 to 30,505.269)	24,805.697(17,977.209 to 33,249.076)	852.564(627.414 to 1122.782)	379.833(276.493 to 506.95)	− 2.864 (− 2.978 to − 2.751)
Netherlands	16,717.435(10,731.352 to 24,995.106)	21,152.37(13,752.524 to 31,959.554)	324.744(204.814 to 492.38)	251.534(160.288 to 387.177)	− 1.213 (− 1.345 to − 1.082)
New Zealand	3465.841(2312.368 to 4951.797)	4964.652(3317.514 to 7034.126)	331.096(217.973 to 477.951)	224.383(147.65 to 322.135)	− 1.158 (− 1.453 to − 0.862)
Nicaragua	3625.423(2620.026 to 4896.269)	6349.38(4547.856 to 8750.463)	838.484(612.046 to 1120.952)	449.685(325.376 to 612.987)	− 2.141 (− 2.194 to − 2.088)
Niger	3997.81(2829.33 to 5443.08)	11,086.02(8065.29 to 14,795.682)	481.064(342.373 to 651.031)	453.382(331.116 to 602.07)	− 0.219 (− 0.257 to − 0.181)
Nigeria	72,079.959(48,137.517 to 101,819.852)	129,887.152(89,662.914 to 179,711.472)	556.93(373.487 to 784.142)	473.874(329.556 to 650.619)	− 0.535 (− 0.664 to − 0.405)

Table 6 (continued)

Location	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Niue	1.535(1.087 to 2.108)	1.193(0.837 to 1.649)	262.658(185.439 to 362.035)	193.217(136.045 to 266.674)	− 1.036 (− 1.093 to − 0.978)
North Macedonia	2665.946(1779.534 to 3844.363)	3382.328(2210.462 to 5025.271)	502.035(338.777 to 718.058)	369.496(241.429 to 549.693)	− 1.293 (− 1.425 to − 1.162)
Northern Mariana Islands	8.348(4.924 to 12.958)	22.146(13.555 to 33.996)	156.301(96.052 to 234.958)	132.222(83.464 to 198.053)	− 0.557 (− 0.647 to − 0.468)
Norway	6710.404(4394.27 to 9766.68)	5895.253(3674.394 to 8958.49)	387.929(243.425 to 584.176)	237.579(144.305 to 368.435)	− 2.602 (− 3.38 to − 1.816)
Oman	800.78(456.473 to 1267.458)	2153.354(1284.963 to 3437.712)	350.932(202.374 to 550.167)	271.808(162.922 to 427.205)	− 1.24 (− 1.355 to − 1.124)
Pakistan	106,046.679(73,836.265 to 145,392.612)	110,812.109(73,311.938 to 157,452.635)	671.763(469.441 to 918.388)	297.899(200.29 to 417.31)	− 2.916 (− 2.995 to − 2.838)
Palau	8.148(5.736 to 11.16)	15.111(10.497 to 21.087)	298.107(210.777 to 406.43)	218.374(154.706 to 299.734)	− 0.991 (− 1.081 to − 0.901)
Palestine	859.315(503.728 to 1327.192)	2992.865(1832.887 to 4641.455)	339.855(200.198 to 523.337)	342.401(210.707 to 527.449)	− 0.189 (− 0.366 to − 0.011)
Panama	2669.168(1789.786 to 3817.339)	4459.946(2918.957 to 6508.74)	634.695(428.709 to 901.637)	364.799(238.98 to 531.995)	− 2.017 (− 2.084 to − 1.95)
Papua New Guinea	1489.744(988.31 to 2131.824)	3927.871(2714.079 to 5494.383)	276.042(184.374 to 391.005)	244.831(170.501 to 338.38)	− 0.342 (− 0.422 to − 0.261)
Paraguay	4596.313(3260.041 to 6382.288)	7210.105(5146.72 to 9769.672)	738.774(524.96 to 1021.306)	437.84(313.001 to 591.973)	− 1.643 (− 1.698 to − 1.588)
Peru	21,111.635(15,117.554 to 28,603.67)	31,940.206(21,680.307 to 45,620.483)	613.238(441.198 to 827.058)	337.314(229.914 to 479.778)	− 2.166 (− 2.246 to − 2.085)
Philippines	26,879.735(18,740.468 to 36,777.069)	57,652.498(41,276.398 to 78,329.325)	315.891(222.079 to 429.037)	239.995(173.324 to 322.814)	− 1.02 (− 1.157 to − 0.883)
Poland	104,718.949(77,203.7 to 137,581.921)	55,829.172(36,230.729 to 81,359.22)	883.466(647.647 to 1165.409)	316.818(201.198 to 470.438)	− 3.583 (− 3.879 to − 3.286)
Portugal	13,624.228(9315.269 to 19,361.243)	14,779.97(10,215.047 to 20,670.612)	363.572(245.601 to 523.402)	264.432(178.403 to 377.378)	− 1.052 (− 1.147 to − 0.956)
Puerto Rico	3553.156(2384.605 to 5103.736)	3536.497(2316.525 to 5165.898)	364.114(243.265 to 524.822)	227.732(146.169 to 339.337)	− 1.73 (− 1.814 to − 1.647)
Qatar	191.428(107.006 to 308.478)	1579.293(930.991 to 2494.127)	375.382(216.144 to 592.803)	331.339(202.904 to 508.246)	− 1.046 (− 1.387 to − 0.705)
Republic of Korea	30,713.12(21,099.731 to 43,415.202)	44,343.039(26,565.544 to 70,777.388)	359.383(252.368 to 497.682)	172.482(103.532 to 275.29)	− 2.662 (− 2.983 to − 2.34)
Republic of Moldova	6709.441(4797.655 to 9226.246)	4832.026(3265.895 to 6998.002)	531.431(380.442 to 730.481)	306.538(206.102 to 446.918)	− 2.039 (− 2.139 to − 1.939)
Romania	48,953.368(35,841.633 to 65,953.75)	32,132.405(21,087.655 to 46,888.066)	620.298(452.815 to 838.624)	353.67(229.966 to 519.932)	− 2.123 (− 2.201 to − 2.045)
Russian Federation	241,932.058(164,994.415 to 337,333.714)	232,639.087(155,888.343 to 331,084.634)	489.795(333.679 to 684.991)	366.103(243.224 to 524.601)	− 1.142 (− 1.331 to − 0.952)
Rwanda	3413.321(2351.124 to 4704.607)	7145.53(5116.085 to 9756.978)	419.488(288.629 to 577.565)	380.425(272.743 to 516.829)	− 0.585 (− 0.657 to − 0.512)
Saint Kitts and Nevis	81.908(64.556 to 102.667)	76.639(53.398 to 106.087)	912.412(713.136 to 1152.674)	348.13(244.16 to 479.258)	− 3.493 (− 3.923 to − 3.06)
Saint Lucia	100.592(68.48 to 140.84)	211.96(144.797 to 300.064)	430.792(291.953 to 605.421)	308.246(211.323 to 435.569)	− 1.243 (− 1.285 to − 1.201)
Saint Vincent and the Grenadines	101.061(73.642 to 134.829)	175.022(129.505 to 234.267)	541.839(392.577 to 727.47)	433.872(320.843 to 580.848)	− 0.78 (− 0.885 to − 0.674)
Samoa	69.211(48.341 to 95.814)	99.971(70.599 to 137.081)	287.119(201.279 to 395.331)	240.67(171.584 to 327.205)	− 0.449 (− 0.592 to − 0.307)

Table 6 (continued)

Location	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
San Marino	20.35(11.768 to 32.864)	36.637(22.029 to 57.881)	232.723(132.71 to 379.87)	216.443(128.211 to 346.328)	− 0.805 (− 0.949 to − 0.66)
Sao Tome and Principe	58.01(41.126 to 79.352)	99.159(69.766 to 138.592)	321.149(227.878 to 438.996)	293.782(208.223 to 406.3)	− 0.546 (− 0.703 to − 0.39)
Saudi Arabia	5850.047(3366.212 to 9275.404)	20,740.318(12,402.451 to 32,923.673)	310.428(181.994 to 485.32)	259.435(156.911 to 404.5)	− 0.626 (− 0.771 to − 0.481)
Senegal	3972.159(2809.712 to 5389.586)	8717.58(6335.911 to 11,675.573)	435.803(309.546 to 589.305)	385.242(281.532 to 512.957)	− 0.51 (− 0.55 to − 0.47)
Serbia	15,074.807(10,076.509 to 21,599.413)	15,555.932(10,988.621 to 21,803.679)	458.68(308.823 to 655.046)	372.748(257.202 to 533.662)	− 1.096 (− 1.28 to − 0.912)
Seychelles	21.773(14.747 to 30.976)	47.72(31.92 to 69.139)	143.74(96.921 to 205.388)	138.691(93.838 to 198.993)	− 0.296 (− 0.361 to − 0.231)
Sierra Leone	2243.349(1545.749 to 3115.383)	4271.455(3173.565 to 5604.369)	396.743(273.898 to 549.774)	383.811(286.624 to 500.41)	− 0.125 (− 0.167 to − 0.084)
Singapore	1432.833(906.537 to 2143.642)	3973.711(2419.225 to 6299.169)	227.12(147.211 to 332.597)	166.213(101.725 to 262.714)	− 1.352 (− 1.471 to − 1.233)
Slovakia	8178.844(5591.262 to 11,564.047)	8939.336(5979.93 to 12,918.132)	512.152(347.241 to 728.697)	367.43(243.105 to 536.753)	− 1.457 (− 1.665 to − 1.249)
Slovenia	3911.487(2713.493 to 5488.492)	4041.712(2728.755 to 5846.719)	584.034(404.401 to 821.022)	381.06(251.522 to 563.064)	− 1.531 (− 1.659 to − 1.403)
Solomon Islands	132.337(91.428 to 182.602)	271.996(195.574 to 376.919)	325.187(225.459 to 446.451)	257.084(186.705 to 350.637)	− 0.708 (− 0.783 to − 0.634)
Somalia	2676.339(1875.969 to 3694.313)	6881.448(4978.782 to 9266.977)	371.852(261.647 to 511.23)	368.502(267.565 to 492.885)	− 0.159 (− 0.228 to − 0.091)
South Africa	18,346.194(12,714.074 to 25,139.291)	37,177.728(26,620.716 to 50,342.321)	311.102(217.093 to 424.097)	276.316(199.603 to 371.216)	− 0.279 (− 0.379 to − 0.178)
South Sudan	2344.743(1555.273 to 3309.75)	4231.651(2992.897 to 5823.62)	326.671(217.309 to 460.393)	362.233(257.535 to 493.78)	0.181 (0.133 to 0.229)
Spain	51,909.084(36,567.164 to 71,806.543)	44,559.169(31,592.656 to 61,332.407)	350.197(243.266 to 490.804)	182.773(126.592 to 256.449)	− 2.304 (− 2.425 to − 2.183)
Sri Lanka	7283.653(4988.524 to 10,323.427)	11,569.694(7910.81 to 16,564.014)	254.281(176.474 to 356.03)	154.467(105.869 to 220.925)	− 1.88 (− 1.947 to − 1.813)
Sudan	11,495.059(6819.669 to 17,688.291)	23,237.747(14,544.674 to 34,970.015)	411.274(244.489 to 631.555)	362.469(228.286 to 541.958)	− 0.769 (− 0.968 to − 0.569)
Suriname	519.879(377.618 to 701.268)	825.488(609.199 to 1100.427)	695.843(506.282 to 935.185)	446.547(330.362 to 594.391)	− 1.596 (− 1.653 to − 1.538)
Sweden	12,651.557(8420.934 to 18,175.083)	10,015.869(6402.502 to 14,826.843)	334.705(214.623 to 494.093)	195.055(119.542 to 298.254)	− 1.797 (− 2.14 to − 1.452)
Switzerland	8249.056(5030.627 to 12,778.996)	12,243.339(7699.951 to 18,844.494)	321.867(192.066 to 506.02)	294.912(181.546 to 461.846)	− 0.857 (− 1.32 to − 0.392)
Syrian Arab Republic	5470.223(3173.163 to 8612.336)	14,074.818(8618.268 to 21,960.253)	340.907(199.382 to 533.902)	319.534(196.966 to 494.913)	− 0.521 (− 0.689 to − 0.352)
Taiwan (Province of China)	11,633.543(8220.531 to 16,076.961)	13,691.09(8894.475 to 20,203.233)	264.782(189.345 to 362.232)	118.64(76.84 to 175.484)	− 3.14 (− 3.332 to − 2.948)
Tajikistan	2520.754(1412.952 to 4000.611)	6655.077(4038.999 to 10,155.129)	316.131(178.125 to 501.491)	334.859(204.988 to 506.637)	− 0.035 (− 0.229 to 0.159)
Thailand	23,022.201(15,607.251 to 32,506.913)	47,835.643(33,108.599 to 67,364.557)	223.403(152.644 to 313.395)	156.236(108.362 to 219.821)	− 1.206 (− 1.236 to − 1.176)
Timor-Leste	215.642(137.486 to 319.803)	636.216(437.031 to 895.415)	264.418(170.247 to 388.39)	265.835(183.23 to 372.873)	− 0.206 (− 0.272 to − 0.141)
Togo	1452.572(1023.183 to 1987.981)	4706.717(3453.304 to 6273.307)	402.119(284.772 to 546.336)	386.154(285.63 to 509.873)	− 0.211 (− 0.244 to − 0.178)

Table 6 (continued)

Location	Prevalence (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Tokelau	1.024(0.715 to 1.413)	0.804(0.559 to 1.127)	272.741(190.268 to 377.031)	196.685(136.441 to 276.528)	− 1.103 (− 1.246 to − 0.96)
Tonga	57.101(40.189 to 79.186)	61.783(45.048 to 83.654)	362.598(256.072 to 500.088)	276.745(202.567 to 372.881)	− 0.74 (− 0.857 to − 0.623)
Trinidad and Tobago	1550.838(1144.586 to 2043.985)	2115.919(1537.984 to 2843.209)	666.121(492.695 to 875.872)	400.1(289.868 to 540.675)	− 1.862 (− 1.929 to − 1.795)
Tunisia	5197.556(2983.353 to 8116.082)	11,834.059(7263.15 to 18,392.474)	348.674(201.21 to 543.093)	305.665(188.085 to 474.078)	− 0.706 (− 0.863 to − 0.548)
Turkey	37,046.235(22,157.869 to 56,237.224)	86,990.827(55,562.131 to 129,948.252)	361.079(217.569 to 545.989)	320.779(205.33 to 477.937)	− 0.511 (− 0.711 to − 0.31)
Turkmenistan	2547.552(1850.404 to 3441.734)	4089.547(2928.303 to 5611.187)	458.052(334.294 to 616.246)	325.233(234.785 to 442.255)	− 1.315 (− 1.428 to − 1.201)
Tuvalu	6.51(4.66 to 8.786)	7.644(5.499 to 10.414)	330.216(237.071 to 444.521)	255.161(184.104 to 346.52)	− 0.746 (− 0.851 to − 0.641)
Uganda	6708.065(4774.279 to 9059.622)	14,988.534(10,837.163 to 20,204.764)	365.228(260.36 to 491.712)	342.22(248.837 to 458.079)	− 0.353 (− 0.388 to − 0.317)
Ukraine	58,110.464(34,033.084 to 89,164.287)	49,736.728(30,642.241 to 75,202.652)	299.115(175.067 to 460.324)	255.166(155.95 to 389.063)	− 0.724 (− 0.897 to − 0.55)
United Arab Emirates	504.108(279.578 to 827.979)	7183.083(4227.967 to 11,631.464)	261.795(149.201 to 421.147)	275.65(165.147 to 432.631)	− 0.039 (− 0.151 to 0.073)
United Kingdom	93,610.288(65,686.595 to 129,410.438)	74,234.212(52,436.712 to 101,287.322)	396.833(270.655 to 561.512)	228.103(157.334 to 317.439)	− 1.645 (− 1.821 to − 1.469)
United Republic of Tanzania	10,036.256(6866.172 to 14,000.313)	24,630.283(17,676.044 to 33,567.703)	319.912(219.552 to 444.784)	328.663(237.25 to 443.903)	− 0.041 (− 0.146 to 0.064)
United States of America	140,164.127(92,012.369 to 203,196.726)	179,262.319(114,434.93 to 266,451.112)	167.499(107.745 to 246.903)	121.311(76.201 to 182.767)	− 0.954 (− 1.314 to − 0.593)
United States Virgin Islands	106.067(70.923 to 151.98)	133.079(92.876 to 184.141)	400.722(270.748 to 568.063)	295.135(202.811 to 414.876)	− 0.951 (− 1.103 to − 0.798)
Uruguay	4327.03(3113.836 to 5913.628)	4342.384(3081.07 to 5945.899)	417.653(298.013 to 576.766)	319.395(222.632 to 444.305)	− 0.848 (− 0.908 to − 0.788)
Uzbekistan	9029.314(5538.175 to 13,553.961)	21,633.141(14,049.606 to 31,811.841)	274.213(169.06 to 410.201)	257.597(168.959 to 375.491)	− 0.332 (− 0.499 to − 0.165)
Vanuatu	75.554(51.911 to 105.175)	163.294(119.363 to 218.576)	422.977(292.273 to 585.062)	316.933(233.529 to 420.171)	− 0.962 (− 1.005 to − 0.918)
Venezuela (Bolivarian Republic of)	17,568.633(11,916.008 to 24,806.254)	38,113.762(27,006.655 to 52,563.744)	639.391(437.698 to 895.679)	442.309(314.022 to 608.69)	− 1.416 (− 1.471 to − 1.361)
Viet Nam	21,500.797(13,859.812 to 31,593.268)	46,420.898(30,987.885 to 66,472.078)	196.202(126.854 to 287.94)	154.963(104.531 to 220.052)	− 1.093 (− 1.18 to − 1.006)
Yemen	6882.703(4082.087 to 10,435.4)	21,043.798(13,511.283 to 31,124.697)	442.448(263.935 to 668.284)	457.652(295.424 to 670.906)	− 0.269 (− 0.435 to − 0.103)
Zambia	3071.83(2142.814 to 4226.035)	7138.07(5226.666 to 9577.044)	375.571(262.395 to 513.963)	340.328(251.017 to 452.097)	− 0.586 (− 0.714 to − 0.458)
Zimbabwe	6405.342(4758.258 to 8514.934)	10,541.541(8008.406 to 13,639.021)	546.746(407.609 to 723.183)	511.832(390.92 to 657.562)	− 0.35 (− 0.412 to − 0.288)

age group was 2.71 (95% CI: 2.69–2.73) times higher than in the control group. The burden of DALYs was 3.32 times (95% CI: 3.29–3.36) greater in the 95–99 age group in females than in controls, and 2.67 times (95% CI: 2.64–2.70) greater in the same age group in males. Analysis of time effects showed a general downward trend in the burden of DALYs, with the overall population, the female population, and the male population all having the highest relative risk in the 1992–1996 period (overall: RR = 1.12, 95% CI: 1.12–1.12; female: RR = 1.11, 95% CI: 1.10–1.11; male: RR = 1.12, 95% CI: 1.12–1.13). Cohort effect analyses showed that the burden of DALYs

Table 7 DALYs due to inguinal, femoral, and abdominal hernia in 204 countries and territories for population aged 45 years and above, 1990–2021

Location	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Afghanistan	785.127(433.583 to 1351.78)	1315.862(729.599 to 2149.674)	38.834(21.348 to 68.548)	36.148(20.124 to 59.388)	− 0.461 (− 0.636 to − 0.285)
Albania	389.145(252.273 to 572.539)	412.248(236.84 to 661.432)	72.554(47.652 to 105.467)	36.151(20.609 to 58.193)	− 2.341 (− 2.502 to − 2.18)
Algeria	963.41(494.913 to 1714.547)	2589.226(1357.737 to 4561.766)	27.868(14.207 to 52.108)	24.209(12.699 to 43.239)	− 0.631 (− 0.796 to − 0.466)
American Samoa	2.841(1.765 to 4.57)	9.185(5.026 to 14.68)	49.695(31.116 to 80.126)	69.753(37.54 to 111.506)	2.074 (1.333 to 2.82)
Andorra	8.037(4.838 to 12.53)	15.893(9.197 to 25.533)	55.945(33.485 to 87.61)	35.427(20.538 to 56.92)	− 1.491 (− 1.602 to − 1.379)
Angola	961.931(501.679 to 1630.535)	2480.89(1406.874 to 4045.848)	98.596(50.053 to 173.388)	84.194(46.442 to 143.104)	− 0.546 (− 0.593 to − 0.499)
Antigua and Barbuda	8.749(6.688 to 11.303)	14.426(10.513 to 19.487)	63.192(47.727 to 82.69)	48.408(35.668 to 64.699)	− 0.951 (− 1.303 to − 0.597)
Argentina	5410.67(4204.704 to 6882.108)	7906.033(6143.252 to 10,051.77)	62.612(48.692 to 79.529)	52.193(40.317 to 66.757)	− 0.068 (− 0.306 to 0.171)
Armenia	630.048(492.102 to 803.857)	769.142(594.41 to 970.306)	84.978(66.721 to 108.009)	64.865(49.88 to 82.413)	− 0.452 (− 0.798 to − 0.105)
Australia	2517.266(1958.633 to 3235.11)	4453.139(3385.811 to 5653.006)	48.174(37.277 to 62.178)	34.345(25.754 to 44.457)	− 0.797 (− 1.098 to − 0.495)
Austria	2210.575(1697.755 to 2857.48)	2010.432(1397.908 to 2808.538)	70.062(52.684 to 92.149)	42.189(28.438 to 60.869)	− 1.611 (− 1.683 to − 1.538)
Azerbaijan	598.677(382.009 to 909.999)	921.811(557.821 to 1422.781)	41.623(26.667 to 63.715)	29.54(17.931 to 45.624)	− 1.347 (− 1.536 to − 1.158)
Bahamas	39.904(31.127 to 50.479)	74.632(55.976 to 98.11)	93.45(73.343 to 117.395)	64.105(48.491 to 83.618)	− 1.181 (− 1.493 to − 0.867)
Bahrain	19.956(12.036 to 30.93)	104.511(59.551 to 170.697)	42.42(27.429 to 62.826)	36.643(22.567 to 56.317)	− 0.163 (− 0.416 to 0.091)
Bangladesh	24,981.382(15,193.343 to 40,636.358)	26,966.22(15,580.309 to 47,750.898)	203.943(123.075 to 331.325)	73.715(42.583 to 130.869)	− 3.625 (− 3.775 to − 3.475)
Barbados	57.302(45.209 to 72.26)	71.045(51.371 to 95.888)	76.781(59.893 to 97.792)	51.157(36.866 to 69.358)	− 1.281 (− 1.398 to − 1.165)
Belarus	2096.266(1573.142 to 2775.454)	2027.394(1409.702 to 2815.932)	59.681(44.671 to 79.204)	46.701(32.198 to 65.452)	− 1.002 (− 1.179 to − 0.826)
Belgium	2367.366(1781.407 to 3152.918)	2426.496(1718.171 to 3332.957)	58.299(42.939 to 79.132)	38.817(26.539 to 55.554)	− 1.526 (− 1.692 to − 1.36)
Belize	19.231(13.857 to 26.344)	60.414(46.964 to 78.05)	76.929(55.466 to 105.373)	71.8(56.249 to 91.751)	− 0.333 (− 0.569 to − 0.096)
Benin	524.399(295.929 to 1262.748)	1139.56(617.925 to 2732.934)	102.074(56.919 to 249.816)	85.726(45.833 to 210.336)	− 0.538 (− 0.589 to − 0.487)
Bermuda	15.957(12.369 to 20.053)	18.519(13.996 to 24.39)	95.801(74.519 to 119.98)	50.583(37.792 to 67.59)	− 2.188 (− 2.638 to − 1.736)
Bhutan	105.534(56.721 to 247.824)	125.57(69.579 to 289.107)	166.811(89.298 to 382.267)	79.223(43.925 to 182.384)	− 2.589 (− 2.73 to − 2.449)
Bolivia (Plurinational State of)	1324.876(734.782 to 2038.091)	2041.343(1255.139 to 3125.04)	152.261(83.003 to 236.153)	82.609(50.11 to 127.264)	− 2.018 (− 2.096 to − 1.941)
Bosnia and Herzegovina	1285.918(948.942 to 1706.506)	746.356(494.067 to 1082.415)	118.42(88.174 to 155.78)	44.991(29.313 to 65.994)	− 3.6 (− 3.888 to − 3.312)
Botswana	179.947(109.293 to 321.88)	284.898(184.147 to 437.034)	121.621(72.864 to 219.038)	71.638(45.975 to 110.165)	− 1.754 (− 1.904 to − 1.605)
Brazil	28,673.389(23,564.685 to 34,922.379)	73,134.085(62,312.15 to 85,388.879)	118.542(98.21 to 142.816)	106.413(90.702 to 123.983)	0.016 (− 0.223 to 0.255)

Table 7 (continued)

Location	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Brunei Darussalam	7.33(4.187 to 11.677)	20.071(11.546 to 32.168)	27.538(15.982 to 43.495)	21.349(12.742 to 33.235)	− 0.523 (− 0.707 to − 0.339)
Bulgaria	3907.523(2962.13 to 5055.066)	1730.522(1231.567 to 2415.461)	120.601(92.244 to 155.184)	46.778(32.652 to 66.457)	− 3.626 (− 3.831 to − 3.42)
Burkina Faso	1050.342(607.87 to 2394.997)	2339.105(1300.757 to 5757.263)	95.853(54.452 to 223.73)	98.683(54.199 to 246.333)	0.178 (0.102 to 0.254)
Burundi	659.959(361.633 to 1334.92)	1316.621(730.484 to 2995.032)	111.738(60.201 to 235.47)	106.994(58.232 to 248.437)	− 0.36 (− 0.445 to − 0.275)
Cabo Verde	36.547(17.966 to 106.126)	66.03(37.846 to 132.902)	59.113(29.21 to 169.918)	54.807(31.485 to 110.586)	− 0.589 (− 0.778 to − 0.399)
Cambodia	1149.641(668.73 to 2036.864)	2453.498(1480.171 to 3962.206)	100.781(58.318 to 180.619)	76.967(46.14 to 123.435)	− 0.896 (− 0.989 to − 0.803)
Cameroon	978.137(584.142 to 1855.789)	2351.727(1375.815 to 4320.445)	86.939(51.415 to 168.811)	73.497(42.478 to 139.519)	− 0.619 (− 0.781 to − 0.458)
Canada	4690.989(3893.955 to 5626.885)	6860.995(5410.533 to 8460.248)	53.68(44.399 to 64.6)	33.241(25.978 to 41.62)	− 1.563 (− 1.911 to − 1.214)
Central African Republic	339.948(180.76 to 552.015)	724.94(394.521 to 1182.983)	116.206(60.861 to 198.489)	126.281(66.208 to 226.833)	0.387 (0.305 to 0.47)
Chad	727.514(397.817 to 1779.326)	1782.493(972.467 to 4450.424)	99.195(53.346 to 249.77)	120.392(63.814 to 313.019)	0.619 (0.486 to 0.752)
Chile	5174.882(4404.589 to 6097.404)	4125.208(3219.079 to 5244.035)	197.152(167.808 to 231.67)	58.217(45.32 to 74.221)	− 3.388 (− 4.226 to − 2.544)
China	39,810.248(25,858.993 to 59,374.099)	69,665.027(42,613.329 to 107,713.378)	18.666(12.524 to 27.403)	11.849(7.388 to 18.103)	− 1.653 (− 1.813 to − 1.494)
Colombia	7123.296(5748.972 to 8821.638)	11,140.071(8452.913 to 14,501.352)	150.947(122.872 to 185.164)	73.821(56.084 to 96.131)	− 2.357 (− 2.778 to − 1.934)
Comoros	54.088(31.228 to 114.601)	115.618(65.966 to 237.518)	106.554(60.702 to 228.057)	91(51.058 to 190.518)	− 0.573 (− 0.615 to − 0.53)
Congo	238.874(136.191 to 383.488)	535.309(312.329 to 865.607)	90.528(50.337 to 150.013)	78.962(44.65 to 131.89)	− 0.432 (− 0.527 to − 0.338)
Cook Islands	2.141(1.34 to 3.264)	2.482(1.452 to 3.954)	61.11(38.391 to 93.222)	34.134(19.949 to 54.316)	− 1.782 (− 1.9 to − 1.663)
Costa Rica	533.742(422.03 to 676.117)	1207.787(945.619 to 1521.252)	114.961(91.284 to 144.763)	80.107(62.738 to 100.991)	− 1.554 (− 1.999 to − 1.107)
Coted'Ivoire	956.415(558.76 to 1921.14)	2406.63(1413.975 to 4720.304)	95.848(55.13 to 199.51)	83.928(48.483 to 170.834)	− 0.458 (− 0.605 to − 0.311)
Croatia	2099.201(1672.426 to 2605.27)	1118.546(840.395 to 1476.456)	132.089(106.011 to 162.473)	46.175(33.815 to 62.299)	− 3.113 (− 3.451 to − 2.774)
Cuba	2851.767(2263.142 to 3600.939)	4629.669(3639.435 to 5821.704)	103.231(81.876 to 130.245)	84.608(66.346 to 106.766)	− 0.805 (− 1.118 to − 0.49)
Cyprus	151.067(93.691 to 234.171)	202.725(126.674 to 312.449)	91.341(55.552 to 146.389)	39.918(24.588 to 62.423)	− 2.784 (− 3.034 to − 2.534)
Czechia	4112.975(3332.393 to 5096.884)	2296.004(1638.729 to 3206.982)	109.947(88.417 to 137.038)	41.273(28.375 to 59.45)	− 2.899 (− 3.298 to − 2.499)
Democratic People's Republic of Korea	644.86(341.494 to 1067.05)	1198.183(642.09 to 2013.236)	14.881(8.168 to 24.311)	12.967(7.025 to 21.693)	− 0.529 (− 0.591 to − 0.468)
Democratic Republic of the Congo	3574.442(2026.078 to 6329.312)	8457.652(4746.703 to 15,082.015)	94.952(52.547 to 175.793)	90.378(48.732 to 168.24)	− 0.06 (− 0.106 to − 0.014)
Denmark	1354.506(1072.668 to 1707.785)	1366.652(1036.312 to 1753.77)	61.696(48.071 to 79.204)	41.878(30.961 to 55.329)	− 1.783 (− 2.019 to − 1.546)
Djibouti	36.831(20.09 to 83.17)	151.852(86.777 to 298.061)	106.956(57.712 to 241.599)	92.777(52.236 to 183.74)	− 0.536 (− 0.618 to − 0.455)
Dominica	11.867(8.058 to 16.937)	12.524(8.231 to 18.274)	76.097(51.567 to 108.976)	54.36(35.619 to 79.485)	− 1.057 (− 1.173 to − 0.94)

Table 7 (continued)

Location	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Dominican Republic	1228.635(792.059 to 1803.071)	1438.818(860.262 to 2236.195)	128.116(81.981 to 188.955)	52.017(31.028 to 81.039)	− 2.658 (− 2.855 to − 2.46)
Ecuador	1461.596(1139.727 to 1871.8)	3108.21(2347.627 to 3993.35)	103.084(80.888 to 131.466)	70.07(53.144 to 89.777)	− 1.079 (− 1.299 to − 0.857)
Egypt	3038.444(1780.906 to 4901.647)	5892.175(3443.829 to 9346.863)	39.331(23.352 to 63.409)	31.699(18.843 to 50.034)	− 1.083 (− 1.302 to − 0.864)
El Salvador	1860.355(1390.247 to 2419.834)	2125.611(1499.35 to 2955.941)	232.873(174.011 to 303.226)	124.049(87.602 to 172.553)	− 2.086 (− 2.398 to − 1.772)
Equatorial Guinea	64.356(36.357 to 118.758)	77.727(45.439 to 125.647)	127.802(71.077 to 243.198)	61.263(34.966 to 100.843)	− 2.791 (− 2.996 to − 2.586)
Eritrea	424.195(238.251 to 801.836)	880.193(498.485 to 1641.833)	143.066(77.408 to 310.559)	125.312(69.059 to 252.251)	− 0.426 (− 0.446 to − 0.405)
Estonia	270.582(199.692 to 364.614)	216.442(150.895 to 306.844)	48.585(35.775 to 65.666)	31.984(21.49 to 46.877)	− 1.839 (− 2.02 to − 1.657)
Eswatini	79.469(48.617 to 135.65)	134.142(83.1 to 212.979)	102.694(62.281 to 177.477)	89.04(54.363 to 143.195)	− 0.06 (− 0.406 to 0.287)
Ethiopia	6487.213(4126.304 to 10,902.308)	9853.593(6041.231 to 21,682.889)	126.069(78.251 to 225.963)	88.516(53.814 to 197.097)	− 1.358 (− 1.457 to − 1.258)
Fiji	34.763(20.632 to 57.111)	79.858(48.931 to 123.885)	36.268(21.447 to 60.744)	38.264(23.223 to 59.914)	1.094 (0.6 to 1.589)
Finland	1162.66(919.303 to 1470.471)	1245.993(934.414 to 1643.88)	60.569(47.295 to 77.545)	37.049(26.694 to 51.33)	− 1.675 (− 1.863 to − 1.487)
France	20,021.819(16,238.667 to 24,526.078)	15,594.516(11,449.106 to 20,679.026)	87.214(69.612 to 108.628)	39.063(27.678 to 54.356)	− 2.829 (− 2.97 to − 2.688)
Gabon	104.556(61.534 to 178.658)	161.941(98.615 to 247.079)	71.36(41.532 to 123.156)	60.713(36.128 to 94.246)	− 0.447 (− 0.541 to − 0.353)
Gambia	104.701(58.965 to 244.722)	259.8(145.935 to 540.889)	117.114(65.414 to 276.376)	103.519(57.472 to 217.779)	− 0.518 (− 0.608 to − 0.428)
Georgia	994.326(766.421 to 1273.884)	943.195(709.676 to 1216.857)	57.621(44.385 to 73.86)	58.264(43.525 to 75.642)	0.371 (− 0.34 to 1.088)
Germany	20,409.718(15,540.586 to 26,872.396)	20,667.896(14,838.645 to 28,398.704)	58.91(44.006 to 78.857)	40.461(27.855 to 58.385)	− 1.018 (− 1.324 to − 0.711)
Ghana	1302.654(784.232 to 2377.603)	3318.613(2043.225 to 5587.764)	83.06(48.922 to 159.032)	79.139(47.636 to 140.989)	− 0.014 (− 0.067 to 0.039)
Greece	1093.799(724.215 to 1600.18)	1285.128(917.084 to 1753.293)	26.965(17.73 to 39.693)	19.508(13.166 to 28.054)	− 1.28 (− 1.653 to − 0.905)
Greenland	4.095(2.773 to 5.782)	7.785(4.981 to 11.163)	45.313(30.635 to 64.201)	42.229(27.17 to 60.854)	0.539 (0.157 to 0.922)
Grenada	15.216(11.46 to 20.058)	27.265(21.373 to 34.674)	83.189(62.279 to 109.903)	83.76(65.9 to 106.014)	0.042 (− 0.273 to 0.358)
Guam	5.595(3.608 to 8.546)	9.36(5.583 to 14.553)	30.41(20.319 to 45.382)	16.38(9.778 to 25.441)	− 1.537 (− 1.833 to − 1.24)
Guatemala	3200.782(2624.918 to 3885.232)	6389.493(5210.995 to 7808.686)	368.103(301.3 to 450.969)	221.596(181.038 to 269.839)	− 1.686 (− 1.981 to − 1.389)
Guinea	805.191(441.709 to 2006.407)	1366.355(749.272 to 3074.989)	94.022(50.824 to 237.922)	94.318(51.155 to 216.21)	0.146 (0.025 to 0.266)
Guinea-Bissau	142.341(78.622 to 255.871)	229.583(131.877 to 412.45)	140.555(76.856 to 266.404)	125.416(70.558 to 241.113)	− 0.158 (− 0.285 to − 0.032)
Guyana	171.311(136.144 to 212.762)	196.971(147.523 to 258.052)	168.243(133.937 to 208.675)	108.102(81.163 to 141.152)	− 0.968 (− 1.363 to − 0.571)
Haiti	1656.728(1050.609 to 2518.659)	2675.285(1672.301 to 4104.255)	187.551(116.824 to 293.561)	136.289(83.849 to 214.148)	− 0.912 (− 0.978 to − 0.846)
Honduras	1283.465(885.129 to 1849.969)	3170.753(1858.596 to 4910.335)	236.301(161.876 to 344.66)	190.603(110.167 to 296.813)	− 0.58 (− 0.72 to − 0.44)

Table 7 (continued)

Location	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Hungary	4696.085(3886.641 to 5681.664)	2563.704(1904.713 to 3412.336)	119.624(98.728 to 145.025)	49.589(35.934 to 67.493)	− 2.672 (− 2.942 to − 2.401)
Iceland	27.129(20.688 to 35.571)	39.151(27.833 to 53.596)	34.972(26.372 to 46.522)	24.381(17.02 to 34.224)	− 1.449 (− 1.826 to − 1.071)
India	250,845.009(190,919.093 to 334,021.107)	289,230.673(211,931.539 to 390,044.692)	207.462(156.71 to 278.489)	92.468(67.35 to 124.641)	− 2.868 (− 3.06 to − 2.675)
Indonesia	62,472.255(41,991.383 to 101,199.549)	122,865.455(81,095.304 to 162,639.83)	258.357(171.117 to 421.753)	212.749(142.594 to 280.577)	− 0.525 (− 0.596 to − 0.455)
Iran (Islamic Republic of)	1793.171(1034.809 to 2820.073)	4546.075(2620.716 to 7342.661)	23.267(13.789 to 36.14)	19.732(11.618 to 31.38)	− 0.5 (− 0.572 to − 0.427)
Iraq	576.623(302.409 to 989.449)	1916.845(1033.122 to 3315.801)	25.375(13.391 to 43.761)	24.228(13.204 to 41.901)	− 0.453 (− 0.653 to − 0.252)
Ireland	795.925(638.135 to 990.145)	717.311(510.054 to 991.293)	73.202(58.062 to 91.902)	33.423(23.339 to 47.055)	− 2.653 (− 2.811 to − 2.494)
Israel	690.801(532.644 to 896.749)	1201.892(849.052 to 1653.8)	55.653(42.446 to 72.753)	35.365(24.44 to 49.956)	− 1.89 (− 2.104 to − 1.676)
Italy	17,083.468(13,395.714 to 21,897.558)	14,999.807(11,242.449 to 19,541.054)	71.451(55.113 to 92.94)	38.279(27.909 to 51.866)	− 2.152 (− 2.268 to − 2.036)
Jamaica	352.992(272.364 to 456.105)	579.052(430.99 to 773.997)	75.943(58.242 to 98.722)	67.665(50.385 to 90.554)	− 0.167 (− 0.435 to 0.101)
Japan	13,421.017(9838.768 to 18,383.579)	20,621.016(14,552.394 to 27,605.8)	29.47(21.656 to 40.098)	20.124(13.58 to 28.821)	− 1.066 (− 1.411 to − 0.718)
Jordan	106.685(54.129 to 181.768)	572.209(300.395 to 960.163)	24.578(12.872 to 41.264)	22.648(12.144 to 37.574)	− 0.43 (− 0.583 to − 0.278)
Kazakhstan	3324.723(2545.314 to 4306.533)	2185.589(1574.234 to 2981.288)	94.319(72.327 to 121.757)	42.601(30.946 to 57.576)	− 3.3 (− 3.635 to − 2.963)
Kenya	2239.318(1311.622 to 4976.637)	6157.51(4152.241 to 11,179.038)	108.008(62.521 to 245.819)	106.198(70.482 to 204.545)	0.258 (0.111 to 0.405)
Kiribati	4.795(2.826 to 7.492)	7.851(4.687 to 12.72)	48.369(28.425 to 77.594)	39.354(23.189 to 65.147)	− 0.532 (− 0.628 to − 0.435)
Kuwait	53.371(27.939 to 88.815)	236.896(126.67 to 396.951)	28.487(15.848 to 45.446)	23.254(13.442 to 37.319)	− 0.307 (− 0.586 to − 0.026)
Kyrgyzstan	373.233(263.851 to 522.178)	524.938(334.655 to 791.044)	45.757(32.4 to 63.904)	35.367(23.091 to 52.559)	− 0.864 (− 1.07 to − 0.658)
Lao People's Democratic Republic	392.605(217.522 to 736.191)	656.822(373.972 to 1201.057)	71.856(39.501 to 136.965)	54.733(30.75 to 100.09)	− 0.917 (− 1.041 to − 0.794)
Latvia	565.378(434.588 to 736.52)	406.377(301.981 to 540.277)	57.744(44.311 to 75.325)	39.652(28.788 to 54.007)	− 1.949 (− 2.249 to − 1.648)
Lebanon	280.832(168.195 to 440.017)	480.934(281.08 to 761.729)	46.889(28.036 to 74.054)	30.077(17.494 to 47.843)	− 1.526 (− 1.614 to − 1.438)
Lesotho	242.477(138.809 to 494.363)	349.432(205.12 to 552.81)	106.86(60.457 to 220.659)	120.583(70.534 to 192.181)	0.898 (0.559 to 1.238)
Liberia	254.725(144.292 to 576.565)	450.601(245.126 to 1088.247)	87.935(49.263 to 202.259)	84.355(45.157 to 210.478)	− 0.473 (− 0.696 to − 0.25)
Libya	139.803(69.217 to 249.045)	435.443(225.902 to 746.321)	25.491(12.685 to 45.66)	24.989(13.02 to 42.734)	− 0.134 (− 0.219 to − 0.05)
Lithuania	851.316(654.419 to 1094.773)	779.197(595.279 to 1010.959)	68.926(52.989 to 88.642)	50.736(37.92 to 67.291)	− 1.238 (− 1.395 to − 1.081)
Luxembourg	105.717(81.056 to 135.903)	118.345(81.459 to 167.15)	72.898(55.414 to 94.408)	40.116(27.085 to 57.706)	− 1.978 (− 2.045 to − 1.911)
Madagascar	1390.397(766.408 to 3284.749)	2839.044(1544.022 to 6723.144)	108.61(58.633 to 263.115)	99.049(52.412 to 246.933)	− 0.226 (− 0.267 to − 0.184)
Malawi	988.597(582.986 to 2113.425)	1815.001(1073.724 to 3643.563)	103.236(59.679 to 223.919)	96.118(55.884 to 197.296)	− 0.285 (− 0.414 to − 0.155)

Table 7 (continued)

Location	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Malaysia	2217.347(1397.817 to 3390.548)	6062.307(3886.482 to 9058.948)	92.374(58.476 to 140.974)	83.467(53.288 to 125.051)	− 0.494 (− 0.671 to − 0.316)
Maldives	19.007(11.386 to 30.501)	33.597(20.723 to 51.691)	92.579(54.426 to 151.057)	40.362(25.455 to 60.869)	− 2.922 (− 3.035 to − 2.809)
Mali	1267.829(694.903 to 2890.048)	2690.573(1396.876 to 6686.498)	127.318(68.721 to 295.841)	121.383(62.067 to 306.854)	0.056 (− 0.022 to 0.134)
Malta	94.825(73.974 to 120.901)	116.885(86.82 to 153.953)	83.918(65.336 to 106.973)	45.183(32.481 to 61.747)	− 2.195 (− 2.423 to − 1.966)
Marshall Islands	2.37(1.424 to 3.79)	3.928(2.32 to 6.249)	56.659(33.846 to 91.873)	43.399(25.457 to 69.931)	− 0.69 (− 0.779 to − 0.6)
Mauritania	232.015(130.709 to 481.454)	409.307(220.99 to 956.771)	90.17(50.026 to 191.112)	73.863(39.474 to 175.525)	− 0.724 (− 0.764 to − 0.684)
Mauritius	25.244(15.248 to 39.16)	88.127(62.225 to 122.34)	12.921(8.073 to 19.599)	17.438(12.408 to 24.085)	0.165 (− 0.251 to 0.583)
Mexico	23,020.204(19,594.62 to 27,280.639)	44,641.356(37,120.566 to 53,600.263)	211.876(182.667 to 247.24)	128.943(107.807 to 153.854)	− 1.295 (− 1.68 to − 0.909)
Micronesia (Federated States of)	6.602(3.974 to 11.111)	7.542(4.553 to 11.887)	51.988(31.08 to 88.819)	36.286(21.89 to 57.625)	− 1.095 (− 1.246 to − 0.945)
Monaco	7.741(4.766 to 12.22)	7.974(4.655 to 12.898)	39.593(23.808 to 63.008)	29.699(17.076 to 48.588)	− 1.053 (− 1.11 to − 0.996)
Mongolia	242.297(163.373 to 346.832)	257.175(162.233 to 388.954)	83.899(56.619 to 120.313)	36.575(23.342 to 54.855)	− 3.328 (− 3.514 to − 3.141)
Montenegro	53.782(31.793 to 85.356)	76.223(44.197 to 120.451)	30.784(18.383 to 48.635)	29.612(17.056 to 46.862)	− 0.504 (− 0.717 to − 0.29)
Morocco	1229.83(638.025 to 2119.084)	2625.447(1400.039 to 4427.338)	30.325(15.837 to 52.808)	25.951(13.947 to 44.142)	− 0.568 (− 0.686 to − 0.45)
Mozambique	1762.622(989.684 to 4095.354)	3575.311(2081.8 to 6787.973)	113.666(62.973 to 267.436)	120.964(69.306 to 234.438)	0.596 (0.456 to 0.736)
Myanmar	5215.834(2826.18 to 9948.288)	7364.606(4231.594 to 12,849.88)	80.716(43.269 to 156.651)	52.876(30.381 to 92.454)	− 1.609 (− 1.775 to − 1.444)
Namibia	223.033(131.661 to 421.216)	383.917(239.588 to 602.019)	130.578(75.5 to 254.53)	103.146(64.075 to 163.807)	− 0.817 (− 1.005 to − 0.628)
Nauru	0.556(0.289 to 0.896)	0.511(0.247 to 0.826)	48.407(24.854 to 79.231)	32.746(15.317 to 53.553)	− 1.187 (− 1.421 to − 0.953)
Nepal	5032.823(2851.337 to 10,635.839)	4806.047(2896.697 to 8553.864)	205.267(114.139 to 438.046)	80.593(48.211 to 144.88)	− 3.281 (− 3.467 to − 3.094)
Netherlands	3892.011(3062.819 to 4896.644)	4084.524(3023.794 to 5432.207)	71.597(55.616 to 91.18)	42.165(30.368 to 57.9)	− 1.828 (− 2.053 to − 1.602)
New Zealand	655.79(517.457 to 821.742)	964.665(737.322 to 1235.57)	61.734(48.28 to 77.927)	40.574(30.635 to 52.818)	− 1.18 (− 1.621 to − 0.738)
Nicaragua	598.879(445.779 to 797.414)	1176.295(848.724 to 1605.025)	147.487(109.942 to 195.852)	89.396(64.472 to 121.751)	− 1.463 (− 1.574 to − 1.351)
Niger	806.166(433.081 to 2109.489)	2521.665(1228.581 to 7856.924)	114.888(60.182 to 308.667)	123.274(58.522 to 392.334)	0.288 (0.265 to 0.31)
Nigeria	10,676.777(6937.182 to 20,544.876)	19,241.064(12,642.417 to 35,661.537)	91.949(59.456 to 181.931)	81.666(53.642 to 156.09)	− 0.329 (− 0.457 to − 0.2)
Niue	0.21(0.132 to 0.319)	0.15(0.091 to 0.232)	34.299(21.605 to 52.078)	24.6(14.943 to 38.039)	− 1.083 (− 1.1 to − 1.066)
North Macedonia	361.907(252.381 to 502.274)	379.731(243.902 to 568.003)	72.194(50.694 to 99.458)	44.647(28.925 to 66.565)	− 1.873 (− 1.993 to − 1.753)
Northern Mariana Islands	0.611(0.252 to 1.153)	1.664(0.771 to 3.011)	11.861(5.574 to 21.153)	10.265(4.932 to 18.067)	− 0.4 (− 0.547 to − 0.253)
Norway	1346.668(1113.362 to 1636.892)	1068.483(819.284 to 1355.616)	69.918(56.291 to 87.54)	37.199(27.8 to 48.81)	− 1.944 (− 2.618 to − 1.265)

Table 7 (continued)

Location	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Oman	64.616(33.803 to 112.303)	163.241(80.986 to 288.543)	30.06(16.112 to 52.253)	22.484(11.674 to 38.647)	− 1.066 (− 1.137 to − 0.994)
Pakistan	19,437.774(11,067.559 to 40,129.293)	20,389.432(13,430.567 to 30,743.603)	132.811(74.297 to 278.001)	64.355(42.447 to 98.234)	− 2.879 (− 3.051 to − 2.707)
Palau	0.98(0.599 to 1.46)	1.63(0.972 to 2.543)	38.036(23.291 to 56.623)	25.171(15.182 to 38.977)	− 1.304 (− 1.352 to − 1.256)
Palestine	128.306(72.879 to 222.159)	271.071(155.975 to 426.793)	55.817(31.436 to 97.881)	35.145(20.779 to 54.416)	− 1.601 (− 1.729 to − 1.473)
Panama	555.148(438.337 to 697.42)	975.329(722.6 to 1279.234)	139.142(110.333 to 174.08)	79.677(59.092 to 104.445)	− 1.894 (− 2.256 to − 1.531)
Papua New Guinea	157.091(85.49 to 324.87)	406.885(219.549 to 784.179)	31.526(17.191 to 66.833)	27.785(14.823 to 55.865)	− 0.292 (− 0.354 to − 0.229)
Paraguay	1130.588(831.681 to 1593.833)	3289.27(2303.266 to 4575.705)	191.037(140.584 to 268.866)	211.751(148.254 to 294.43)	1.004 (0.807 to 1.202)
Peru	3231.205(2212.015 to 4527.388)	4752.777(3040.726 to 7039.498)	97.705(66.766 to 137.194)	51.102(32.736 to 75.625)	− 2.512 (− 2.791 to − 2.231)
Philippines	5016.657(3426.2 to 8376.217)	13,114.901(10,194.719 to 16,835.524)	66.803(45.535 to 110.785)	58.869(45.715 to 75.023)	− 0.281 (− 0.384 to − 0.178)
Poland	18,482.251(15,735.944 to 21,802.888)	8299.476(6455.534 to 10,677.663)	160.146(136.094 to 188.847)	43.047(32.619 to 56.892)	− 4.688 (− 5.132 to − 4.242)
Portugal	2592.572(2066.578 to 3261.823)	3118.669(2377.31 to 4017.752)	71.577(56.734 to 90.333)	44.543(32.936 to 59.417)	− 1.368 (− 1.716 to − 1.018)
Puerto Rico	1309.587(1091.492 to 1561.716)	597.667(437.39 to 807.014)	137.324(114.426 to 163.818)	33.373(23.854 to 46.355)	− 4.698 (− 5.845 to − 3.537)
Qatar	17.468(9.038 to 31.011)	129.507(63.246 to 231.562)	47.246(25.247 to 88.598)	35.268(18.442 to 61.793)	− 0.798 (− 1.064 to − 0.531)
Republic of Korea	3082.365(1983.101 to 4463.485)	4194.028(2316.991 to 7022.645)	40.703(27.285 to 57.102)	16.47(9.102 to 27.569)	− 3.062 (− 3.373 to − 2.75)
Republic of Moldova	1173.665(935.796 to 1476.348)	901.685(689.341 to 1182.55)	102.191(81.913 to 127.643)	55.693(42.349 to 73.529)	− 2.263 (− 2.595 to − 1.93)
Romania	7209.029(5652.931 to 9152.478)	3918.496(2768.404 to 5492.55)	95.541(75.312 to 120.625)	40.458(27.96 to 57.998)	− 3.084 (− 3.358 to − 2.81)
Russian Federation	37,109.712(30,538.202 to 45,729.792)	40,028.104(32,803.895 to 49,084.503)	76.914(63.346 to 94.622)	61.586(50.169 to 76.067)	− 1.223 (− 1.397 to − 1.048)
Rwanda	886.226(551.515 to 1561.304)	1663.686(901.009 to 4070.943)	125.455(75.604 to 235.235)	105.119(56.038 to 261.537)	− 0.965 (− 1.142 to − 0.787)
Saint Kitts and Nevis	12.777(10.166 to 15.851)	12.538(9.009 to 16.798)	136.652(107.823 to 170.895)	64.819(47.418 to 85.635)	− 2.291 (− 2.813 to − 1.766)
Saint Lucia	17.555(13.22 to 22.901)	34.199(24.959 to 46.787)	77.822(58.74 to 101.383)	51.003(37.306 to 69.612)	− 1.444 (− 1.773 to − 1.114)
Saint Vincent and the Grenadines	20.518(16.357 to 25.588)	39.661(31.725 to 49.549)	110.849(88.145 to 138.647)	101.67(81.526 to 126.69)	− 0.249 (− 0.698 to 0.202)
Samoa	8.167(4.97 to 13.411)	11.876(7.167 to 19.338)	35.99(21.946 to 59.096)	29.925(18.11 to 48.801)	− 0.517 (− 0.637 to − 0.397)
San Marino	3.022(1.778 to 4.778)	4.237(2.215 to 7.216)	31.715(18.257 to 50.911)	20.657(10.42 to 35.931)	− 1.395 (− 1.57 to − 1.219)
Sao Tome and Principe	12.191(6.753 to 28.378)	18.602(10.896 to 34.985)	72.091(39.576 to 170.491)	65.316(38.035 to 125.599)	− 0.314 (− 0.488 to − 0.139)
Saudi Arabia	488.569(258.333 to 821.329)	1529.267(782.701 to 2631.561)	27.582(14.888 to 46.106)	20.5(10.732 to 34.91)	− 0.908 (− 1.029 to − 0.787)
Senegal	972.339(544.758 to 2265.231)	1889.48(1080.983 to 3900.09)	117.538(65.48 to 275.223)	94.071(53.301 to 194.856)	− 0.739 (− 0.798 to − 0.68)
Serbia	2674.764(1901.461 to 3667.781)	2644.861(1865.774 to 3639.654)	95.332(67.716 to 130.744)	58.957(41.014 to 82.251)	− 1.831 (− 1.97 to − 1.691)

Table 7 (continued)

Location	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Seychelles	2.963(1.862 to 4.507)	4.993(2.8 to 8.11)	19.523(12.216 to 29.758)	15.091(8.638 to 24.295)	– 0.944 (– 1.043 to – 0.845)
Sierra Leone	468.758(263.542 to 1054.319)	909.684(495.781 to 2236.158)	89.079(49.622 to 202.746)	93.189(50.246 to 233.422)	0.339 (0.256 to 0.421)
Singapore	204.241(146.595 to 281.586)	416.862(254.35 to 661.063)	35.188(25.961 to 47.246)	17.737(10.913 to 27.938)	– 2.106 (– 2.43 to – 1.78)
Slovakia	1327.548(978.371 to 1771.083)	1123.415(757 to 1620.293)	82.791(60.776 to 110.844)	44.57(29.709 to 65.005)	– 2.152 (– 2.205 to – 2.099)
Slovenia	768.367(619.997 to 954.554)	532.587(379.69 to 726.671)	113.972(91.6 to 142.031)	44.448(30.474 to 62.756)	– 3.221 (– 3.383 to – 3.059)
Solomon Islands	14.48(7.974 to 26.707)	29.985(16.957 to 52.299)	38.853(21.307 to 74.214)	30.534(17.247 to 54.372)	– 0.68 (– 0.757 to – 0.603)
Somalia	741.807(386.385 to 1775.817)	1745.375(870.762 to 3809.359)	124.548(62.613 to 319.56)	114.524(54.651 to 270.445)	– 0.302 (– 0.346 to – 0.259)
South Africa	3721.34(2675.624 to 5524.836)	9259.072(7353.408 to 11,414.479)	66.892(47.948 to 99.598)	73.594(58.684 to 90.254)	0.679 (0.457 to 0.901)
South Sudan	729.205(390.522 to 1628.083)	1117.89(604.534 to 2629.192)	111.074(59.113 to 248.51)	112.327(59.722 to 270.308)	– 0.089 (– 0.15 to – 0.027)
Spain	11,419.711(9263.465 to 13,996.104)	11,241.023(8535.988 to 14,207.659)	77.019(61.98 to 95.051)	37.437(28.032 to 48.524)	– 2.348 (– 2.566 to – 2.13)
Sri Lanka	2131.186(1370.595 to 3353.266)	2466.334(1513.8 to 3773.775)	84.104(54.552 to 131.088)	34.618(21.366 to 52.776)	– 2.75 (– 2.842 to – 2.657)
Sudan	932.783(499.717 to 1539.279)	1819.605(1007.552 to 3037.863)	34.6(18.555 to 57.715)	29.737(16.55 to 49.82)	– 0.707 (– 0.864 to – 0.551)
Suriname	94.744(66.051 to 132.668)	157.011(103.907 to 231.162)	133.827(92.945 to 188.224)	88.189(58.08 to 130.181)	– 1.295 (– 1.397 to – 1.194)
Sweden	2257.239(1787.491 to 2854.441)	1755.244(1301.256 to 2320.848)	54.639(42.201 to 70.87)	28.859(20.49 to 39.966)	– 1.708 (– 2.053 to – 1.362)
Switzerland	1361.915(1011.996 to 1837.94)	1818.166(1248.575 to 2546.805)	48.864(35.504 to 67.458)	36.614(24.152 to 53.701)	– 1.195 (– 1.453 to – 0.937)
Syrian Arab Republic	448.335(235.212 to 758.673)	1085.037(561.784 to 1821.746)	29.285(15.622 to 49.983)	25.963(13.585 to 44.3)	– 0.629 (– 0.75 to – 0.508)
Taiwan (Province of China)	1208.598(820.832 to 1737.09)	1598.397(1039.07 to 2393.724)	30.273(21.325 to 42.212)	13.597(8.764 to 20.505)	– 3.407 (– 3.636 to – 3.177)
Tajikistan	263.963(154.95 to 438.164)	569.645(315.89 to 918.581)	34.333(20.199 to 57.532)	30.77(17.389 to 49.192)	– 0.599 (– 0.814 to – 0.383)
Thailand	5616.332(3375.8 to 9054.896)	11,442.028(7129.706 to 17,622.973)	58.974(35.504 to 94.833)	37.701(23.488 to 58.047)	– 1.395 (– 1.528 to – 1.262)
Timor-Leste	50.535(23.392 to 152.448)	155.12(79.545 to 355.816)	69.506(32.245 to 205.679)	70.043(35.67 to 160.649)	0.018 (– 0.035 to 0.072)
Togo	348.416(188.884 to 836.459)	1045.592(621.58 to 2109.115)	112.211(59.777 to 277.887)	105.074(60.921 to 223.737)	– 0.217 (– 0.292 to – 0.141)
Tokelau	0.16(0.095 to 0.272)	0.11(0.066 to 0.176)	43.43(25.906 to 74.055)	26.883(16.095 to 43.191)	– 1.582 (– 1.625 to – 1.538)
Tonga	7.819(4.624 to 14.839)	8.727(5.265 to 14.61)	52.96(31.174 to 101.638)	39.528(23.916 to 66.146)	– 0.75 (– 0.835 to – 0.665)
Trinidad and Tobago	254.532(201.768 to 318.086)	324.793(238.242 to 433.706)	114.367(90.997 to 142.355)	61.76(45.299 to 82.582)	– 2.185 (– 2.356 to – 2.014)
Tunisia	405.29(209.26 to 697.903)	881.025(460.195 to 1528.016)	28.105(14.59 to 49.12)	23.121(12.115 to 40.138)	– 0.819 (– 0.952 to – 0.684)
Turkey	5753.091(3624.33 to 8654.628)	9566.571(5948.239 to 14,691.407)	61.493(38.749 to 92.793)	36.893(23.046 to 56.425)	– 1.677 (– 1.775 to – 1.578)
Turkmenistan	379.105(289.088 to 497.091)	569.217(416.815 to 764.408)	71.704(54.906 to 93.479)	48.304(35.678 to 64.393)	– 1.771 (– 1.963 to – 1.579)

Table 7 (continued)

Location	DALYs (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Tuvalu	0.881(0.543 to 1.394)	1.011(0.605 to 1.605)	49.086(29.9 to 79.01)	35.609(21.221 to 56.698)	− 0.881 (− 0.941 to − 0.821)
Uganda	1295.725(747.368 to 2353.248)	2543.191(1527.4 to 4105.351)	79.025(44.664 to 148.033)	66.619(39.306 to 110.758)	− 0.808 (− 0.917 to − 0.698)
Ukraine	6977.264(4788.099 to 9908.712)	6556.08(4492.428 to 9226.522)	35.711(24.374 to 50.851)	32.443(21.987 to 46.061)	− 0.647 (− 0.821 to − 0.473)
United Arab Emirates	89.325(51.73 to 141.235)	622.678(318.201 to 1068.683)	75.168(44.663 to 118.991)	44.963(25.032 to 75.343)	− 0.458 (− 0.856 to − 0.058)
United Kingdom	20,736.214(17,784.532 to 24,239.292)	21,651.548(18,252.219 to 24,915.667)	83.073(70.132 to 98.738)	57.786(48.399 to 67.605)	− 1.186 (− 1.452 to − 0.919)
United Republic of Tanzania	2447.58(1412.58 to 5130.036)	5448.759(3130.432 to 11,308.594)	87.99(50.039 to 187.002)	82.218(46.694 to 173.598)	− 0.161 (− 0.345 to 0.025)
United States of America	41,404.66(35,803.793 to 47,514.948)	47,012.034(39,003.68 to 55,804.206)	47.61(40.939 to 55.103)	29.454(24.334 to 35.406)	− 1.67 (− 2.206 to − 1.131)
United States Virgin Islands	14.172(9.237 to 20.772)	13.559(8.404 to 20.355)	58.774(38.387 to 86.45)	29.537(18.078 to 44.887)	− 2.248 (− 2.383 to − 2.112)
Uruguay	844.679(674.599 to 1044.056)	1041.495(837.323 to 1287.656)	79.946(63.46 to 99.446)	68.101(54.245 to 85.501)	− 0.39 (− 0.65 to − 0.13)
Uzbekistan	1000.647(647.79 to 1493.101)	2014.364(1240.945 to 3025.088)	31.354(20.546 to 46.38)	25.393(16.129 to 37.521)	− 0.727 (− 0.897 to − 0.557)
Vanuatu	10.27(5.527 to 22.467)	23.399(12.953 to 47.438)	64.066(33.74 to 150.389)	50.168(27.308 to 107.762)	− 0.778 (− 0.814 to − 0.742)
Venezuela (Bolivarian Republic of)	4572.417(3730.239 to 5592.095)	8530.678(6260.627 to 11,251.845)	179.859(147.21 to 219.129)	103.31(76.065 to 135.826)	− 2.063 (− 2.472 to − 1.652)
Viet Nam	3509.819(1949.489 to 6323.086)	6308.359(3581.127 to 10,008.138)	33.234(18.435 to 59.878)	23.294(13.3 to 36.893)	− 1.321 (− 1.418 to − 1.225)
Yemen	546.742(301.481 to 903.447)	1630.272(942.49 to 2651.14)	36.717(20.204 to 61.426)	37.269(21.656 to 60.929)	− 0.244 (− 0.376 to − 0.113)
Zambia	736.414(451.047 to 1371.533)	1503.629(942.31 to 2300.08)	102.101(61.731 to 196.054)	83.249(51.218 to 131.257)	− 0.807 (− 1.024 to − 0.589)
Zimbabwe	1298.944(841.832 to 1937.529)	2299.595(1392.801 to 3565.751)	120.679(78.052 to 180.294)	122.608(74.186 to 190.528)	0.296 (0.037 to 0.556)

was higher in the earlier birth cohorts, with the 1897–1901 birth cohort having a significantly higher burden of DALYs than the other cohorts (overall: RR = 1.40, 95% CI: 1.37–1.44; female: RR = 1.46, 95% CI: 1.41–1.50; male: RR = 1.48, 95% CI: 1.43–1.54) (Fig. 9C).

The results of the mortality analyses were similar to the trends in DALYs, with the study results showing a continued upward trend with age. In the overall population, the risk of death in the 95–99 age group was 6.57 times (95% CI: 6.42–6.73) higher than that of the control group. There were significant gender differences, with females in the 95–99 age group having a risk of death 7.51 times (95% CI: 7.28–7.74) that of controls, while males in the same age group had a risk of death 6.67 times (95% CI: 6.43–6.93) that of controls. Analysis of time effects showed that mortality rates fluctuated over the study period, with the overall and female populations having the highest relative risks during 2017–2021 (overall: RR = 1.12, 95% CI: 1.10–1.13; female: RR = 1.15, 95% CI: 1.13–1.17), and the male population also having the highest risk during the same period (RR = 1.09, 95% CI: 1.08–1.11). Analysis of cohort effects showed that mortality was higher in the earlier birth cohorts, with the 1897–1901 birth cohort having a significantly higher risk of death than the other cohorts (overall: RR = 2.13, 95% CI: 1.98–2.28; female: RR = 2.16, 95% CI: 1.97–2.36; male: RR = 2.27, 95% CI: 2.03–2.54) (Fig. 9D).

Health inequality in inguinal, femoral and abdominal hernia burden: a global analysis

The burden of disease showed significant health inequalities globally (Fig. 10). The degree of inequality in incidence, prevalence and mortality was assessed using the slope index (SII) and concentration index (CII) (Table 13). The results showed that the degree of inequality in the burden of disease varied significantly across

Table 8 Mortality of inguinal, femoral, and abdominal hernia in 204 countries and territories for population aged 45 years and above, 1990–2021

Location	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Afghanistan	11.019(4.51 to 28.165)	11.239(4.558 to 25.445)	0.704(0.285 to 1.827)	0.558(0.237 to 1.265)	– 0.612 (– 0.711 to – 0.512)
Albania	10.389(6.673 to 15.375)	9.088(5.11 to 15.404)	2.401(1.539 to 3.544)	0.829(0.469 to 1.396)	– 3.387 (– 3.882 to – 2.89)
Algeria	7.913(3.303 to 23.059)	17.584(7.995 to 41.846)	0.379(0.15 to 1.207)	0.251(0.111 to 0.636)	– 0.759 (– 1.005 to – 0.513)
American Samoa	0.074(0.039 to 0.139)	0.288(0.106 to 0.519)	1.659(0.904 to 3.071)	2.56(0.956 to 4.57)	2.604 (1.603 to 3.615)
Andorra	0.305(0.165 to 0.517)	0.696(0.376 to 1.16)	2.551(1.391 to 4.298)	1.39(0.753 to 2.322)	– 1.674 (– 1.871 to – 1.477)
Angola	25.802(8.86 to 52.021)	68.812(28.219 to 133.013)	3.718(1.349 to 7.628)	3.319(1.391 to 6.536)	– 0.351 (– 0.41 to – 0.292)
Antigua and Barbuda	0.295(0.242 to 0.356)	0.41(0.315 to 0.508)	1.903(1.554 to 2.303)	1.593(1.238 to 1.963)	– 0.528 (– 1.144 to 0.091)
Argentina	189.662(156.334 to 226.505)	289.793(237.858 to 342.598)	2.371(1.95 to 2.831)	1.827(1.5 to 2.16)	– 0.011 (– 0.394 to 0.374)
Armenia	18.485(15.136 to 23.214)	25.993(20.708 to 31.15)	2.776(2.269 to 3.5)	2.171(1.728 to 2.605)	– 0.137 (– 0.651 to 0.381)
Australia	101.421(84.055 to 118.428)	242.767(190.868 to 289.287)	2.011(1.661 to 2.345)	1.652(1.304 to 1.971)	– 0.113 (– 0.513 to 0.288)
Austria	82.499(70.098 to 95.486)	74.896(58.993 to 88.296)	2.424(2.05 to 2.805)	1.199(0.954 to 1.414)	– 1.946 (– 2.297 to – 1.595)
Azerbaijan	11.581(6.856 to 20.222)	14.082(7.331 to 25.37)	0.936(0.55 to 1.661)	0.586(0.309 to 1.042)	– 1.443 (– 1.642 to – 1.243)
Bahamas	1.12(0.901 to 1.365)	2.136(1.633 to 2.754)	2.902(2.339 to 3.531)	2.14(1.642 to 2.742)	– 0.938 (– 1.377 to – 0.498)
Bahrain	0.313(0.216 to 0.44)	1.394(0.864 to 2.125)	1.153(0.798 to 1.626)	1.196(0.754 to 1.796)	1.302 (0.694 to 1.914)
Bangladesh	995.874(564.328 to 1679.736)	926.957(481.321 to 1853.366)	9.192(5.212 to 15.344)	3.006(1.594 to 5.872)	– 4.055 (– 4.323 to – 3.786)
Barbados	2.215(1.807 to 2.704)	2.407(1.71 to 3.164)	2.665(2.177 to 3.233)	1.687(1.203 to 2.214)	– 1.345 (– 1.523 to – 1.166)
Belarus	63.182(50.276 to 78.401)	63.582(45.37 to 83.052)	1.856(1.476 to 2.3)	1.411(1.005 to 1.844)	– 0.883 (– 1.095 to – 0.671)
Belgium	87.308(72.65 to 101.577)	106.496(81.902 to 127.566)	2.049(1.699 to 2.38)	1.279(0.997 to 1.53)	– 1.833 (– 2.134 to – 1.531)
Belize	0.62(0.447 to 0.882)	1.869(1.495 to 2.286)	2.509(1.805 to 3.569)	2.571(2.059 to 3.136)	0.053 (– 0.294 to 0.402)
Benin	19.278(8.72 to 56.211)	38.229(16.599 to 112.163)	4.223(1.904 to 12.384)	3.566(1.561 to 10.413)	– 0.452 (– 0.516 to – 0.387)
Bermuda	0.576(0.45 to 0.697)	0.788(0.613 to 0.992)	3.761(2.957 to 4.541)	1.894(1.471 to 2.389)	– 2.316 (– 3.022 to – 1.606)
Bhutan	3.248(1.377 to 8.633)	4.97(2.391 to 13.35)	6.674(2.974 to 16.536)	3.459(1.686 to 9.101)	– 2.268 (– 2.421 to – 2.115)
Bolivia (Plurinational State of)	38.343(14.617 to 66.197)	61.35(29.008 to 105.845)	5.189(2.012 to 8.972)	2.905(1.378 to 4.993)	– 1.847 (– 1.94 to – 1.755)
Bosnia and Herzegovina	33.858(24.252 to 45.095)	22.069(15.071 to 32.231)	3.747(2.681 to 4.981)	1.252(0.852 to 1.83)	– 4.213 (– 4.772 to – 3.65)
Botswana	5.394(2.82 to 10.756)	8.382(4.738 to 14.358)	4.687(2.43 to 9.299)	2.704(1.543 to 4.56)	– 1.655 (– 1.854 to – 1.457)
Brazil	728.696(661.897 to 788.123)	2725.576(2369.405 to 2992.571)	3.599(3.229 to 3.907)	4.129(3.577 to 4.536)	0.969 (0.704 to 1.235)

Table 8 (continued)

Location	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Brunei Darussalam	0.183(0.098 to 0.296)	0.388(0.234 to 0.606)	0.916(0.483 to 1.529)	0.7(0.417 to 1.096)	– 0.032 (– 0.398 to 0.335)
Bulgaria	92.676(78.484 to 108.252)	46.255(36.255 to 57.484)	3.785(3.215 to 4.42)	1.158(0.913 to 1.431)	– 3.914 (– 4.283 to – 3.543)
Burkina Faso	32.085(14.612 to 91.556)	73.692(31.115 to 227.533)	3.761(1.717 to 10.688)	3.861(1.659 to 11.646)	0.181 (0.091 to 0.271)
Burundi	23.383(10.685 to 55.938)	39.599(17.508 to 111.217)	4.723(2.135 to 11.856)	4.317(1.929 to 11.877)	– 0.56 (– 0.667 to – 0.454)
Cabo Verde	1.402(0.505 to 5.288)	2.38(1.139 to 5.952)	2.137(0.768 to 8.113)	2.124(1.023 to 5.237)	– 0.444 (– 0.713 to – 0.175)
Cambodia	39.57(20.161 to 78.091)	84.741(44.473 to 147.244)	4.266(2.195 to 8.379)	3.306(1.761 to 5.602)	– 0.809 (– 0.903 to – 0.714)
Cameroon	31.299(15.714 to 71.478)	73.678(36.225 to 163.442)	3.542(1.793 to 8.079)	3.028(1.502 to 6.782)	– 0.504 (– 0.676 to – 0.332)
Canada	232.263(193.855 to 270.065)	399.844(321.015 to 475.906)	2.686(2.236 to 3.123)	1.734(1.399 to 2.065)	– 1.416 (– 1.809 to – 1.022)
Central African Republic	9.206(3.475 to 17.548)	19.116(7.187 to 38.487)	4.39(1.755 to 8.812)	4.915(1.903 to 10.911)	0.571 (0.457 to 0.686)
Chad	24.064(9.692 to 76.326)	56.96(23.729 to 178.831)	3.783(1.513 to 12.252)	4.926(2.033 to 15.666)	0.885 (0.751 to 1.019)
Chile	216.107(184.474 to 250.745)	162.731(133.599 to 191.673)	9.128(7.766 to 10.572)	2.248(1.846 to 2.648)	– 3.739 (– 4.8 to – 2.666)
China	686.43(467.724 to 973.553)	1083.361(800.196 to 1423.729)	0.51(0.358 to 0.73)	0.234(0.172 to 0.305)	– 2.712 (– 3.02 to – 2.403)
Colombia	205.364(175.657 to 236.395)	398.013(311.011 to 492.187)	5.019(4.28 to 5.781)	2.621(2.057 to 3.241)	– 2.136 (– 2.737 to – 1.531)
Comoros	1.696(0.81 to 4.232)	3.968(1.856 to 9.809)	4.302(2.077 to 10.502)	3.809(1.785 to 9.296)	– 0.419 (– 0.464 to – 0.373)
Congo	7.247(3.184 to 13.549)	15.699(6.878 to 29.423)	3.687(1.62 to 7.022)	3.286(1.456 to 6.287)	– 0.29 (– 0.398 to – 0.183)
Cook Islands	0.043(0.021 to 0.082)	0.055(0.022 to 0.116)	1.398(0.711 to 2.65)	0.748(0.306 to 1.58)	– 1.935 (– 1.984 to – 1.886)
Costa Rica	19.383(16.14 to 22.946)	47.229(37.438 to 56.728)	4.425(3.677 to 5.242)	3.101(2.468 to 3.722)	– 1.628 (– 2.265 to – 0.986)
Coted'Ivoire	26.832(12.493 to 67.062)	70.758(33.37 to 171.38)	3.831(1.807 to 9.523)	3.376(1.607 to 8.215)	– 0.318 (– 0.499 to – 0.137)
Croatia	78.333(65.938 to 91.837)	43.393(34.742 to 52.588)	5.558(4.679 to 6.496)	1.559(1.248 to 1.889)	– 3.783 (– 4.239 to – 3.324)
Cuba	99.329(81.811 to 118.987)	190.396(151.979 to 232.233)	3.753(3.083 to 4.489)	3.311(2.642 to 4.043)	– 0.54 (– 0.998 to – 0.08)
Cyprus	6.935(3.981 to 11.419)	8.309(5.06 to 12.996)	5.629(3.236 to 9.494)	1.862(1.125 to 2.964)	– 3.619 (– 4.003 to – 3.233)
Czechia	156.594(134.655 to 179.825)	70.953(59.449 to 82.651)	4.228(3.621 to 4.855)	1.096(0.918 to 1.277)	– 3.841 (– 4.517 to – 3.16)
Democratic People's Republic of Korea	12.167(5.923 to 21.325)	22.433(10.174 to 42.684)	0.416(0.207 to 0.724)	0.287(0.133 to 0.543)	– 1.07 (– 1.181 to – 0.959)
Democratic Republic of the Congo	107.142(50.276 to 229.625)	245.627(102.878 to 528.219)	3.979(1.85 to 8.708)	3.613(1.508 to 7.95)	– 0.168 (– 0.217 to – 0.12)
Denmark	59.271(49.304 to 69.411)	67.182(53.727 to 79.777)	2.483(2.064 to 2.906)	1.775(1.424 to 2.109)	– 1.632 (– 1.941 to – 1.323)
Djibouti	1.081(0.49 to 2.823)	4.359(2.033 to 10.096)	4.46(2.082 to 11.195)	3.841(1.836 to 8.608)	– 0.521 (– 0.596 to – 0.446)
Dominica	0.411(0.253 to 0.625)	0.397(0.236 to 0.626)	2.622(1.619 to 4.006)	1.859(1.103 to 2.929)	– 1.041 (– 1.168 to – 0.914)

Table 8 (continued)

Location	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Dominican Republic	44.508(25.721 to 69.909)	47.404(24.022 to 81.921)	5.643(3.297 to 8.785)	1.804(0.917 to 3.114)	− 3.174 (− 3.481 to − 2.866)
Ecuador	45.61(36.811 to 58.266)	104.415(80.256 to 132.448)	3.652(2.948 to 4.661)	2.506(1.939 to 3.161)	− 0.846 (− 1.238 to − 0.453)
Egypt	50.265(28.571 to 85.002)	80.317(46.293 to 132.567)	1.028(0.576 to 1.782)	0.717(0.409 to 1.196)	− 1.784 (− 2.168 to − 1.398)
El Salvador	70.963(50.185 to 98.061)	95.708(63.592 to 137.205)	9.255(6.551 to 12.784)	5.236(3.48 to 7.521)	− 1.863 (− 2.209 to − 1.515)
Equatorial Guinea	1.977(0.912 to 4.257)	2.307(1.062 to 4.345)	5.077(2.362 to 11.206)	2.419(1.103 to 4.546)	− 2.782 (− 2.968 to − 2.594)
Eritrea	11.831(5.367 to 26.67)	26.895(12.426 to 60.024)	5.893(2.621 to 15.862)	5.415(2.524 to 12.81)	− 0.245 (− 0.277 to − 0.214)
Estonia	8.028(6.481 to 9.851)	7.123(5.647 to 8.71)	1.472(1.189 to 1.801)	0.816(0.649 to 0.997)	− 2.542 (− 2.924 to − 2.159)
Eswatini	2.498(1.355 to 4.719)	4.128(2.203 to 7.064)	4.072(2.201 to 7.754)	3.471(1.84 to 6.041)	0.038 (− 0.32 to 0.397)
Ethiopia	174.14(85.61 to 361.356)	295.932(152.476 to 839.84)	4.558(2.262 to 10.145)	3.278(1.693 to 9.063)	− 1.263 (− 1.39 to − 1.137)
Fiji	0.744(0.351 to 1.56)	2.005(0.963 to 3.63)	1.027(0.487 to 2.171)	1.212(0.59 to 2.182)	1.723 (1.002 to 2.449)
Finland	47.928(39.745 to 55.776)	58.95(46.496 to 70.923)	2.449(2.021 to 2.853)	1.353(1.077 to 1.624)	− 1.801 (− 2.037 to − 1.563)
France	1011.035(853.433 to 1171.089)	852.397(661.869 to 1024.111)	4.106(3.456 to 4.758)	1.547(1.211 to 1.865)	− 3.371 (− 3.596 to − 3.146)
Gabon	3.657(1.773 to 7.198)	5.021(2.488 to 8.631)	2.936(1.432 to 5.75)	2.491(1.222 to 4.31)	− 0.408 (− 0.524 to − 0.292)
Gambia	3.301(1.519 to 9.193)	9.199(4.254 to 22.087)	4.619(2.167 to 12.577)	4.357(2.032 to 10.336)	− 0.173 (− 0.252 to − 0.095)
Georgia	32.976(25.842 to 40.988)	29.516(22.315 to 37.766)	2.019(1.581 to 2.508)	1.711(1.292 to 2.197)	− 0.038 (− 1.27 to 1.21)
Germany	776.27(649.493 to 900.85)	924.39(723.861 to 1111.785)	2.108(1.754 to 2.447)	1.377(1.089 to 1.651)	− 0.693 (− 1.558 to 0.18)
Ghana	37.966(18.066 to 87.033)	104.681(53.332 to 213.437)	3.224(1.522 to 7.599)	3.309(1.67 to 7.121)	0.268 (0.197 to 0.339)
Greece	28.677(24.117 to 33.591)	59.584(47.434 to 70.671)	0.749(0.627 to 0.875)	0.64(0.512 to 0.76)	− 0.935 (− 1.54 to − 0.326)
Greenland	0.126(0.081 to 0.185)	0.249(0.142 to 0.381)	1.961(1.256 to 2.904)	1.806(1.064 to 2.741)	0.71 (0.152 to 1.272)
Grenada	0.534(0.402 to 0.72)	0.84(0.661 to 1.048)	2.503(1.888 to 3.366)	2.914(2.3 to 3.621)	0.568 (0.111 to 1.026)
Guam	0.121(0.08 to 0.19)	0.168(0.097 to 0.271)	0.957(0.644 to 1.473)	0.316(0.182 to 0.508)	− 2.519 (− 3.089 to − 1.945)
Guatemala	110.837(90.227 to 137.847)	265.628(213.231 to 325.042)	16.768(13.493 to 21.275)	10.289(8.289 to 12.502)	− 1.496 (− 1.772 to − 1.219)
Guinea	27.975(11.939 to 86.191)	47.463(21.376 to 128.531)	3.796(1.611 to 11.647)	3.886(1.763 to 10.534)	0.248 (0.125 to 0.37)
Guinea-Bissau	4.413(1.906 to 9.48)	6.877(3.243 to 14.878)	5.505(2.46 to 12.577)	5.153(2.461 to 11.825)	0.073 (− 0.073 to 0.218)
Guyana	5.254(4.159 to 6.561)	5.744(4.143 to 7.733)	5.967(4.712 to 7.478)	3.7(2.686 to 4.938)	− 0.958 (− 1.449 to − 0.464)
Haiti	44.999(22.805 to 78.983)	75.881(38.374 to 134.809)	6.386(3.211 to 11.667)	4.98(2.529 to 8.952)	− 0.592 (− 0.675 to − 0.509)
Honduras	38.632(23.333 to 62.991)	110.475(51.719 to 188.946)	8.32(4.996 to 13.795)	7.817(3.678 to 13.319)	− 0.04 (− 0.205 to 0.126)

Table 8 (continued)

Location	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Hungary	182.082(157.072 to 210.808)	87.528(70.747 to 106.657)	4.928(4.241 to 5.697)	1.489(1.202 to 1.818)	− 3.533 (− 3.942 to − 3.122)
Iceland	1.162(0.937 to 1.395)	1.883(1.431 to 2.313)	1.394(1.125 to 1.673)	1.004(0.771 to 1.235)	− 1.272 (− 1.686 to − 0.857)
India	7518.474(5361.989 to 10,686.35)	9521.784(6422.822 to 13,471.38)	7.974(5.621 to 11.405)	3.59(2.389 to 5.057)	− 2.716 (− 2.984 to − 2.447)
Indonesia	2254.459(1359.88 to 3985.144)	4650.804(2806.739 to 6397.9)	11.584(6.96 to 20.333)	10.451(6.651 to 14.174)	− 0.165 (− 0.252 to − 0.077)
Iran (Islamic Republic of)	14.001(8.742 to 20.713)	41.495(27.874 to 55.041)	0.3(0.191 to 0.445)	0.233(0.157 to 0.309)	− 0.502 (− 0.873 to − 0.13)
Iraq	6.005(2.809 to 14.885)	11.633(5.572 to 26.114)	0.305(0.142 to 0.76)	0.237(0.115 to 0.54)	− 0.938 (− 1.103 to − 0.773)
Ireland	34.282(29.036 to 39.756)	28.381(22.217 to 34.272)	3.256(2.746 to 3.771)	1.208(0.948 to 1.459)	− 3.033 (− 3.281 to − 2.783)
Israel	27.706(23.232 to 32.373)	56.742(43.925 to 68.023)	2.387(1.994 to 2.785)	1.451(1.128 to 1.741)	− 2.22 (− 2.535 to − 1.904)
Italy	578.736(510.721 to 624.316)	599.666(477.292 to 677.783)	2.406(2.104 to 2.603)	1.122(0.914 to 1.261)	− 2.599 (− 2.812 to − 2.386)
Jamaica	12.112(9.777 to 15.027)	20.16(14.784 to 26.535)	2.441(1.968 to 3.033)	2.262(1.661 to 2.989)	0.048 (− 0.358 to 0.454)
Japan	402.327(352.896 to 432.276)	1029.189(741.42 to 1204.87)	0.97(0.837 to 1.048)	0.585(0.442 to 0.675)	− 0.708 (− 1.444 to 0.033)
Jordan	0.478(0.289 to 0.78)	2.196(1.399 to 3.264)	0.178(0.108 to 0.293)	0.153(0.099 to 0.226)	0.278 (− 0.105 to 0.663)
Kazakhstan	80.218(61.834 to 102.201)	50.779(38.556 to 65.404)	2.501(1.928 to 3.181)	1.168(0.889 to 1.496)	− 3.285 (− 3.707 to − 2.861)
Kenya	72.131(34.456 to 202.328)	178.702(105.095 to 418.075)	4.3(2.062 to 11.955)	4.188(2.432 to 10.151)	0.218 (0.076 to 0.36)
Kiribati	0.091(0.039 to 0.186)	0.155(0.066 to 0.321)	1.201(0.526 to 2.493)	1.057(0.458 to 2.186)	− 0.198 (− 0.301 to − 0.094)
Kuwait	0.279(0.218 to 0.342)	2.044(1.522 to 2.578)	0.239(0.187 to 0.294)	0.35(0.259 to 0.441)	4.881 (3.211 to 6.578)
Kyrgyzstan	7.482(5.912 to 9.23)	6.406(4.877 to 8.154)	0.999(0.787 to 1.232)	0.563(0.428 to 0.718)	− 1.786 (− 2.267 to − 1.304)
Lao People's Democratic Republic	12.462(5.787 to 27.063)	21.365(9.712 to 44.365)	2.775(1.286 to 6.018)	2.229(1.027 to 4.521)	− 0.741 (− 0.893 to − 0.588)
Latvia	17.799(14.635 to 21.049)	15.415(12.4 to 18.688)	1.837(1.509 to 2.172)	1.231(0.99 to 1.497)	− 1.983 (− 2.403 to − 1.562)
Lebanon	7.248(3.954 to 12.373)	11.842(7.143 to 18.268)	1.507(0.823 to 2.581)	0.655(0.395 to 1.012)	− 2.502 (− 2.584 to − 2.42)
Lesotho	8.191(3.942 to 19.304)	11.286(5.942 to 19.177)	4.098(1.94 to 9.765)	4.618(2.44 to 7.91)	1.089 (0.712 to 1.467)
Liberia	8.54(3.922 to 23.614)	13.877(5.771 to 42.969)	3.553(1.634 to 9.781)	3.434(1.432 to 10.622)	− 0.432 (− 0.71 to − 0.154)
Libya	1.69(0.6 to 4.398)	3.579(1.413 to 8.073)	0.386(0.136 to 1.007)	0.314(0.123 to 0.712)	− 0.001 (− 0.413 to 0.412)
Lithuania	27.967(23.085 to 33.321)	31.783(25.643 to 38.278)	2.295(1.893 to 2.73)	1.719(1.388 to 2.071)	− 1.139 (− 1.514 to − 0.763)
Luxembourg	4.077(3.433 to 4.748)	4.716(3.708 to 5.682)	2.882(2.424 to 3.351)	1.381(1.09 to 1.665)	− 2.061 (− 2.364 to − 1.757)
Madagascar	49.294(23.055 to 136.549)	83.557(36.655 to 247.564)	4.701(2.172 to 13.141)	4.15(1.817 to 12.381)	− 0.267 (− 0.317 to − 0.217)
Malawi	32.802(16.604 to 80.129)	57.767(28.821 to 137.33)	4.399(2.203 to 10.715)	3.896(1.928 to 9.269)	− 0.364 (− 0.508 to − 0.219)

Table 8 (continued)

Location	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Malaysia	81.243(45.933 to 134.476)	237.923(134.046 to 384.387)	3.691(2.099 to 6.087)	3.774(2.125 to 6.088)	− 0.179 (− 0.487 to 0.129)
Maldives	0.644(0.331 to 1.136)	1.294(0.754 to 2.066)	4.35(2.237 to 7.684)	1.864(1.094 to 2.937)	− 2.876 (− 2.959 to − 2.794)
Mali	41.917(18.742 to 113.507)	91.101(38.374 to 269.021)	5.455(2.461 to 14.579)	5.287(2.246 to 15.477)	0.222 (0.116 to 0.328)
Malta	3.773(3.114 to 4.473)	5.61(4.339 to 6.866)	3.568(2.932 to 4.225)	1.8(1.398 to 2.204)	− 2.418 (− 2.662 to − 2.174)
Marshall Islands	0.056(0.024 to 0.11)	0.08(0.032 to 0.156)	1.591(0.713 to 3.151)	1.314(0.55 to 2.511)	− 0.365 (− 0.514 to − 0.216)
Mauritania	7.713(3.39 to 19.715)	14.627(6.455 to 41.61)	3.558(1.57 to 9.127)	3.147(1.394 to 8.884)	− 0.399 (− 0.443 to − 0.355)
Mauritius	0.433(0.359 to 0.518)	2.669(2.163 to 3.201)	0.284(0.236 to 0.338)	0.575(0.467 to 0.689)	0.514 (− 0.28 to 1.315)
Mexico	775.485(725.777 to 819.709)	1536.284(1331.245 to 1741.744)	8.646(8.048 to 9.156)	4.842(4.199 to 5.482)	− 1.524 (− 1.937 to − 1.11)
Micronesia (Federated States of)	0.161(0.071 to 0.361)	0.149(0.069 to 0.283)	1.441(0.65 to 3.224)	0.976(0.467 to 1.834)	− 1.254 (− 1.331 to − 1.177)
Monaco	0.343(0.186 to 0.584)	0.381(0.2 to 0.655)	1.474(0.795 to 2.499)	1.081(0.571 to 1.859)	− 0.944 (− 0.968 to − 0.919)
Mongolia	4.268(2.52 to 6.963)	4.629(2.859 to 7.16)	1.69(0.995 to 2.773)	0.927(0.567 to 1.434)	− 2.668 (− 2.924 to − 2.412)
Montenegro	0.851(0.567 to 1.235)	1.311(0.853 to 1.899)	0.537(0.358 to 0.781)	0.56(0.364 to 0.809)	0.033 (− 0.249 to 0.314)
Morocco	12.184(5.585 to 33.485)	23.938(11.589 to 58.606)	0.365(0.166 to 1.008)	0.301(0.146 to 0.748)	− 0.194 (− 0.394 to 0.007)
Mozambique	56.78(27.084 to 154.984)	109.152(53.317 to 240.781)	4.645(2.217 to 12.551)	4.754(2.309 to 10.59)	0.523 (0.372 to 0.674)
Myanmar	155.281(69.668 to 338.809)	219.103(107.736 to 427.664)	2.775(1.236 to 6.167)	1.816(0.908 to 3.52)	− 1.649 (− 1.832 to − 1.465)
Namibia	6.954(3.508 to 15.092)	12.366(6.845 to 21.324)	5.122(2.521 to 11.499)	4.123(2.298 to 7.197)	− 0.683 (− 0.884 to − 0.482)
Nauru	0.014(0.005 to 0.026)	0.012(0.003 to 0.024)	1.656(0.618 to 3.138)	1.064(0.32 to 2.009)	− 1.261 (− 1.527 to − 0.993)
Nepal	150.604(65.032 to 379.092)	160.556(81.744 to 339.719)	7.898(3.428 to 19.557)	3.289(1.689 to 6.846)	− 3.086 (− 3.295 to − 2.878)
Netherlands	194.151(160.684 to 225.586)	205.665(162.968 to 245.525)	3.476(2.865 to 4.043)	1.85(1.469 to 2.208)	− 2.02 (− 2.485 to − 1.554)
New Zealand	26.673(22.287 to 31.075)	47.335(37.726 to 56.144)	2.546(2.117 to 2.969)	1.837(1.467 to 2.179)	− 0.909 (− 1.464 to − 0.352)
Nicaragua	17.871(12.67 to 24.665)	38.699(26.358 to 54.837)	5.088(3.599 to 7.037)	3.335(2.258 to 4.735)	− 1 (− 1.178 to − 0.822)
Niger	23.855(9.947 to 77.709)	82.81(30.315 to 321.173)	4.561(1.912 to 14.66)	5.358(1.992 to 20.14)	0.608 (0.559 to 0.657)
Nigeria	296.641(167.253 to 744.267)	541.822(303.473 to 1311.67)	3.224(1.824 to 8.087)	3.081(1.77 to 7.359)	− 0.013 (− 0.16 to 0.135)
Niue	0.006(0.003 to 0.011)	0.004(0.002 to 0.007)	0.9(0.476 to 1.577)	0.657(0.322 to 1.159)	− 1.002 (− 1.095 to − 0.91)
North Macedonia	9.858(6.767 to 13.589)	9.196(6.244 to 13.181)	2.239(1.532 to 3.088)	1.398(0.96 to 1.991)	− 1.845 (− 2.083 to − 1.608)
Northern Mariana Islands	0.002(0.001 to 0.004)	0.009(0.003 to 0.018)	0.089(0.051 to 0.149)	0.089(0.026 to 0.172)	0.356 (− 0.296 to 1.011)
Norway	64.624(56.792 to 70.525)	55.478(45.146 to 62.205)	3.032(2.663 to 3.311)	1.639(1.347 to 1.833)	− 1.238 (− 2.026 to − 0.445)

Table 8 (continued)

Location	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Oman	0.524(0.251 to 1.205)	0.953(0.477 to 1.75)	0.361(0.173 to 0.834)	0.272(0.134 to 0.506)	0.032 (– 0.485 to 0.553)
Pakistan	608.072(258.253 to 1577.099)	619.689(378.571 to 1044.423)	5.004(2.112 to 12.817)	2.604(1.598 to 4.374)	– 2.725 (– 2.938 to – 2.512)
Palau	0.022(0.011 to 0.037)	0.027(0.013 to 0.049)	1(0.501 to 1.693)	0.588(0.291 to 1.046)	– 1.712 (– 1.78 to – 1.645)
Palestine	3.76(1.775 to 7.695)	3.805(2.32 to 5.877)	1.942(0.921 to 3.951)	0.776(0.472 to 1.188)	– 2.977 (– 3.162 to – 2.791)
Panama	19.777(16.038 to 24.391)	39.121(28.901 to 49.733)	5.357(4.337 to 6.609)	3.134(2.318 to 3.985)	– 1.779 (– 2.305 to – 1.25)
Papua New Guinea	2.351(0.771 to 8.146)	6.147(2.059 to 19.545)	0.681(0.239 to 2.224)	0.614(0.21 to 1.893)	– 0.145 (– 0.231 to – 0.06)
Paraguay	42.046(29.482 to 62.385)	147.269(98.724 to 210.052)	7.664(5.386 to 11.318)	10.058(6.76 to 14.309)	1.75 (1.513 to 1.987)
Peru	85.221(50.485 to 131.328)	135.513(78.496 to 218.574)	2.838(1.685 to 4.368)	1.495(0.865 to 2.41)	– 2.6 (– 3.031 to – 2.166)
Philippines	144.991(83.704 to 284.868)	411.824(297.268 to 538.837)	2.624(1.592 to 4.74)	2.201(1.592 to 2.848)	– 0.182 (– 0.316 to – 0.049)
Poland	708.793(657.24 to 751.295)	329.756(284.571 to 365.882)	6.63(6.079 to 7.055)	1.514(1.31 to 1.679)	– 5.476 (– 6.033 to – 4.917)
Portugal	106.713(90.124 to 124.594)	167.283(132.696 to 200.378)	3.245(2.732 to 3.776)	1.892(1.508 to 2.268)	– 1.496 (– 2.049 to – 0.939)
Puerto Rico	57.958(48.967 to 68.129)	23.37(18.072 to 29.048)	6.421(5.421 to 7.545)	0.995(0.772 to 1.241)	– 6.105 (– 7.782 to – 4.397)
Qatar	0.199(0.088 to 0.475)	1.041(0.441 to 2.465)	1.343(0.608 to 3.191)	0.847(0.382 to 1.789)	– 0.374 (– 1.112 to 0.369)
Republic of Korea	57.159(36.743 to 77.669)	97.118(64.261 to 143.321)	1.177(0.78 to 1.587)	0.401(0.264 to 0.592)	– 3.492 (– 3.72 to – 3.264)
Republic of Moldova	36.092(29.878 to 43.103)	32.12(25.582 to 39.46)	3.874(3.215 to 4.604)	1.928(1.538 to 2.37)	– 2.6 (– 3.181 to – 2.017)
Romania	200.74(169.796 to 235.249)	109.71(87.442 to 134.366)	3.086(2.622 to 3.594)	0.983(0.783 to 1.203)	– 4.01 (– 4.526 to – 3.49)
Russian Federation	1111.686(1049.444 to 1162.234)	1422.047(1264.739 to 1552.792)	2.53(2.366 to 2.654)	2.133(1.895 to 2.33)	– 1.159 (– 1.559 to – 0.757)
Rwanda	28.501(14.778 to 59.166)	54.878(24.14 to 161.168)	5.237(2.649 to 11.641)	4.558(2.04 to 12.997)	– 0.823 (– 1.012 to – 0.633)
Saint Kitts and Nevis	0.394(0.324 to 0.48)	0.351(0.251 to 0.457)	4.102(3.369 to 4.997)	2.336(1.731 to 2.988)	– 1.33 (– 1.907 to – 0.75)
Saint Lucia	0.554(0.432 to 0.704)	1.08(0.795 to 1.405)	2.724(2.136 to 3.442)	1.698(1.251 to 2.207)	– 1.66 (– 2.264 to – 1.052)
Saint Vincent and the Grenadines	0.716(0.582 to 0.874)	1.395(1.127 to 1.704)	4.046(3.29 to 4.932)	3.86(3.134 to 4.689)	– 0.107 (– 0.758 to 0.548)
Samoa	0.172(0.081 to 0.36)	0.263(0.13 to 0.527)	0.921(0.438 to 1.874)	0.775(0.388 to 1.539)	– 0.56 (– 0.646 to – 0.474)
San Marino	0.137(0.081 to 0.212)	0.168(0.087 to 0.288)	1.321(0.783 to 2.046)	0.506(0.259 to 0.881)	– 2.243 (– 2.655 to – 1.829)
Sao Tome and Principe	0.449(0.199 to 1.287)	0.616(0.311 to 1.404)	2.971(1.319 to 8.586)	2.767(1.405 to 6.239)	– 0.003 (– 0.218 to 0.212)
Saudi Arabia	4.857(2.199 to 10.151)	6.875(3.414 to 13.845)	0.403(0.184 to 0.839)	0.215(0.109 to 0.437)	– 1.827 (– 1.962 to – 1.693)
Senegal	33.847(15.78 to 91.427)	64.458(30.109 to 154.022)	4.861(2.288 to 12.993)	3.881(1.836 to 9.085)	– 0.735 (– 0.807 to – 0.662)
Serbia	93.163(63.843 to 131.678)	104.479(72.098 to 145.008)	4.127(2.822 to 5.825)	2.179(1.502 to 3.021)	– 2.253 (– 2.376 to – 2.13)

Table 8 (continued)

Location	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Seychelles	0.077(0.043 to 0.129)	0.091(0.046 to 0.172)	0.507(0.283 to 0.846)	0.33(0.168 to 0.608)	− 1.449 (− 1.628 to − 1.27)
Sierra Leone	16.298(7.251 to 43.891)	30.014(13.351 to 90.659)	3.564(1.595 to 9.602)	3.784(1.707 to 11.323)	0.424 (0.316 to 0.532)
Singapore	5.6(4.622 to 6.709)	10.078(7.908 to 12.095)	1.167(0.961 to 1.394)	0.451(0.354 to 0.54)	− 2.503 (− 3.127 to − 1.875)
Slovakia	44.555(32.199 to 59.151)	33.744(23.415 to 47.682)	2.857(2.058 to 3.797)	1.291(0.896 to 1.823)	− 2.484 (− 2.693 to − 2.274)
Slovenia	29.198(24.659 to 34.127)	20.161(16.025 to 24.206)	4.378(3.671 to 5.145)	1.346(1.071 to 1.621)	− 4.022 (− 4.31 to − 3.734)
Solomon Islands	0.237(0.081 to 0.68)	0.512(0.199 to 1.263)	0.904(0.332 to 2.513)	0.706(0.276 to 1.733)	− 0.686 (− 0.766 to − 0.607)
Somalia	22.623(9.225 to 65.605)	51.419(18.259 to 138.309)	5.25(2.124 to 15.997)	4.668(1.7 to 13.306)	− 0.321 (− 0.378 to − 0.263)
South Africa	116.422(77.722 to 190.882)	305.005(238.506 to 376.82)	2.406(1.604 to 3.92)	2.829(2.226 to 3.47)	0.91 (0.664 to 1.157)
South Sudan	26.532(12.241 to 66.948)	36.502(16.329 to 100.33)	4.755(2.223 to 11.778)	4.807(2.175 to 13.129)	− 0.048 (− 0.097 to 0)
Spain	527.27(445.491 to 609.614)	677.885(520.779 to 816.827)	3.642(3.062 to 4.213)	1.813(1.407 to 2.183)	− 2.178 (− 2.425 to − 1.931)
Sri Lanka	86.165(51.594 to 143.487)	94.245(52.952 to 153.44)	4.221(2.589 to 6.845)	1.486(0.849 to 2.387)	− 3.071 (− 3.205 to − 2.937)
Sudan	8.28(3.404 to 19.467)	13.88(6.13 to 31.116)	0.407(0.164 to 0.981)	0.334(0.146 to 0.762)	− 0.307 (− 0.467 to − 0.147)
Suriname	2.808(1.723 to 4.374)	4.914(2.803 to 8.022)	4.408(2.701 to 6.859)	2.999(1.709 to 4.894)	− 1.05 (− 1.198 to − 0.902)
Sweden	96.111(81.323 to 110.489)	85.659(67.309 to 102.915)	2.067(1.745 to 2.378)	1.135(0.898 to 1.366)	− 1.322 (− 1.718 to − 0.926)
Switzerland	53.939(44.422 to 63.427)	81.726(62.74 to 97.468)	1.739(1.431 to 2.044)	1.241(0.963 to 1.48)	− 1.071 (− 1.262 to − 0.879)
Syrian Arab Republic	4.32(2.155 to 10.019)	7.963(3.89 to 17.782)	0.389(0.195 to 0.906)	0.309(0.149 to 0.742)	− 0.733 (− 0.806 to − 0.66)
Taiwan (Province of China)	24.616(20.643 to 28.875)	51.395(40.225 to 62.147)	0.867(0.722 to 1.016)	0.412(0.324 to 0.499)	− 3.574 (− 3.995 to − 3.151)
Tajikistan	4.535(2.512 to 9.07)	5.507(3.006 to 9.016)	0.673(0.369 to 1.376)	0.45(0.243 to 0.741)	− 1.538 (− 1.851 to − 1.224)
Thailand	180.679(96.457 to 318.876)	458.204(260.63 to 758.562)	2.222(1.2 to 3.872)	1.528(0.871 to 2.527)	− 1.059 (− 1.288 to − 0.829)
Timor-Leste	1.473(0.518 to 5.272)	5.541(2.192 to 15.143)	2.692(0.985 to 8.995)	2.951(1.194 to 7.804)	0.373 (0.296 to 0.45)
Togo	11.542(5.125 to 33.442)	31.753(15.63 to 78.448)	4.704(2.097 to 13.737)	4.355(2.135 to 11.088)	− 0.249 (− 0.345 to − 0.153)
Tokelau	0.005(0.002 to 0.01)	0.003(0.002 to 0.006)	1.396(0.671 to 2.891)	0.776(0.389 to 1.453)	− 1.908 (− 2.032 to − 1.783)
Tonga	0.197(0.09 to 0.502)	0.246(0.119 to 0.497)	1.585(0.737 to 3.973)	1.16(0.566 to 2.338)	− 0.828 (− 0.927 to − 0.729)
Trinidad and Tobago	7.263(5.987 to 8.725)	8.92(6.262 to 12.039)	3.72(3.07 to 4.456)	1.74(1.225 to 2.343)	− 2.533 (− 2.831 to − 2.234)
Tunisia	3.168(1.412 to 8.868)	6.372(3.087 to 14.049)	0.302(0.135 to 0.837)	0.2(0.098 to 0.443)	− 1.126 (− 1.268 to − 0.983)
Turkey	159.295(90.468 to 261.62)	221.953(136.306 to 338.487)	2.017(1.145 to 3.31)	0.976(0.601 to 1.484)	− 2.138 (− 2.351 to − 1.925)
Turkmenistan	9.044(7.157 to 11.598)	12.382(8.929 to 16.568)	1.975(1.556 to 2.532)	1.252(0.898 to 1.676)	− 2.249 (− 2.542 to − 1.955)

Table 8 (continued)

Location	Mortality (95% UI)				
	Counts in 1990	Counts in 2021	Age standardized rate in 1990 (per 100 000)	Age standardized rate in 2021 (per 100 000)	EAPC (95% CI)
Tuvalu	0.019(0.009 to 0.038)	0.024(0.011 to 0.046)	1.382(0.668 to 2.72)	0.976(0.465 to 1.859)	− 0.891 (− 1.003 to − 0.78)
Uganda	40.278(18.269 to 89.367)	73.212(34.44 to 144.213)	3.096(1.403 to 6.975)	2.514(1.175 to 5.004)	− 0.897 (− 1.019 to − 0.775)
Ukraine	145.852(118.358 to 177.187)	162.286(116.79 to 218.006)	0.759(0.616 to 0.921)	0.745(0.535 to 1.002)	− 0.448 (− 0.655 to − 0.24)
United Arab Emirates	2.272(1.245 to 3.858)	5.713(3.076 to 9.932)	2.976(1.641 to 5.002)	1.635(0.885 to 2.875)	0.191 (− 0.477 to 0.863)
United Kingdom	965.518(876.917 to 1016.779)	1246.023(1055.762 to 1355.792)	3.697(3.34 to 3.9)	2.908(2.487 to 3.158)	− 0.76 (− 1.083 to − 0.436)
United Republic of Tanzania	80.485(39.329 to 196.754)	181.645(87.152 to 449.69)	3.63(1.777 to 8.797)	3.378(1.629 to 8.337)	− 0.119 (− 0.326 to 0.087)
United States of America	1964.536(1729.122 to 2110.233)	2289.319(1907.571 to 2516.023)	2.154(1.896 to 2.314)	1.307(1.101 to 1.432)	− 1.755 (− 2.33 to − 1.177)
United States Virgin Islands	0.323(0.187 to 0.528)	0.279(0.147 to 0.464)	1.719(1.003 to 2.807)	0.58(0.31 to 0.963)	− 3.534 (− 3.704 to − 3.363)
Uruguay	31.829(26.463 to 37.637)	49.697(40.948 to 58.579)	3.005(2.495 to 3.55)	2.782(2.302 to 3.282)	− 0.017 (− 0.381 to 0.349)
Uzbekistan	18.457(13.274 to 24.816)	25.187(19.007 to 32.698)	0.637(0.458 to 0.856)	0.419(0.316 to 0.541)	− 1.145 (− 1.411 to − 0.878)
Vanuatu	0.227(0.077 to 0.762)	0.553(0.207 to 1.619)	1.914(0.656 to 6.55)	1.548(0.58 to 4.613)	− 0.667 (− 0.752 to − 0.582)
Venezuela (Bolivarian Republic of)	165.106(136.537 to 199.756)	304.914(215.617 to 407.255)	7.335(6.047 to 8.874)	3.972(2.83 to 5.28)	− 2.234 (− 2.788 to − 1.676)
Viet Nam	111.2(47.972 to 238.906)	171.466(83.887 to 300.349)	1.161(0.508 to 2.46)	0.771(0.385 to 1.334)	− 1.423 (− 1.548 to − 1.297)
Yemen	3.965(1.622 to 9.525)	11.591(5.197 to 25.498)	0.394(0.157 to 0.959)	0.407(0.183 to 0.908)	0.156 (0.048 to 0.265)
Zambia	23.846(12.583 to 52.69)	44.916(23.859 to 78.694)	4.195(2.207 to 9.311)	3.294(1.727 to 5.94)	− 0.803 (− 1.037 to − 0.568)
Zimbabwe	37.693(20.828 to 62.368)	63.593(30.957 to 109.612)	4.344(2.438 to 7.072)	4.383(2.204 to 7.45)	0.508 (0.183 to 0.834)

indicators and changed over time. For morbidity, the SII was 143.72 (95% CI: 177.30–143.72) in 1990, decreasing to 76.30 (95% CI: 91.55–76.30) by 2021, suggesting that there is a higher prevalence of morbidity in people with high socio-economic status (SES), but that this degree of inequality has decreased. The CII also decreased from 0.14 in 1990 (95% CI: 0.10–0.19) to 0.06 (95% CI: 0.02–0.09) in 2021, further confirming this trend. Inequality in prevalence showed an opposite trend, with SII decreasing from − 36.48 (95% CI: 23.31 to − 36.48) in 1990 to − 115.31 (95% CI: − 78.80 to − 115.31) in 2021, suggesting that prevalence was higher among those of lower socioeconomic status and that this inequality had increased. CII also decreased from − 0.11 (95% CI: − 0.15 to − 0.06) to − 0.14 (95% CI: − 0.17 to − 0.11), supporting this observation. Inequality in mortality was relatively stable but still showed a slight trend towards increasing. The SII decreased from − 0.68 (95% CI: − 0.03 to − 0.68) in 1990 to − 0.89 (95% CI: − 0.45 to − 0.89) in 2021. However, CII showed a slight improvement from − 0.14 (95% CI: − 0.20 to − 0.08) to − 0.12 (95% CI: − 0.18 to − 0.06). Overall, these results reveal a complex pattern of distribution of disease burden among populations of varying socioeconomic status. Although inequalities in morbidity have been reduced, inequalities in prevalence and mortality persist and have even increased.

Correlation analysis between hernia burden and socio-demographic index

Correlation analysis of the burden of disease with SDI for inguinal, femoral, and abdominal wall hernias in people aged 45 years and older revealed complex spatial and temporal patterns (Figs. 11, 12 and 13). Comparison of data from 1990 and 2021 revealed the evolution of the relationship between the burden of disease indicators and the SDI (Fig. 11). In 1990, age-standardized incidence rate

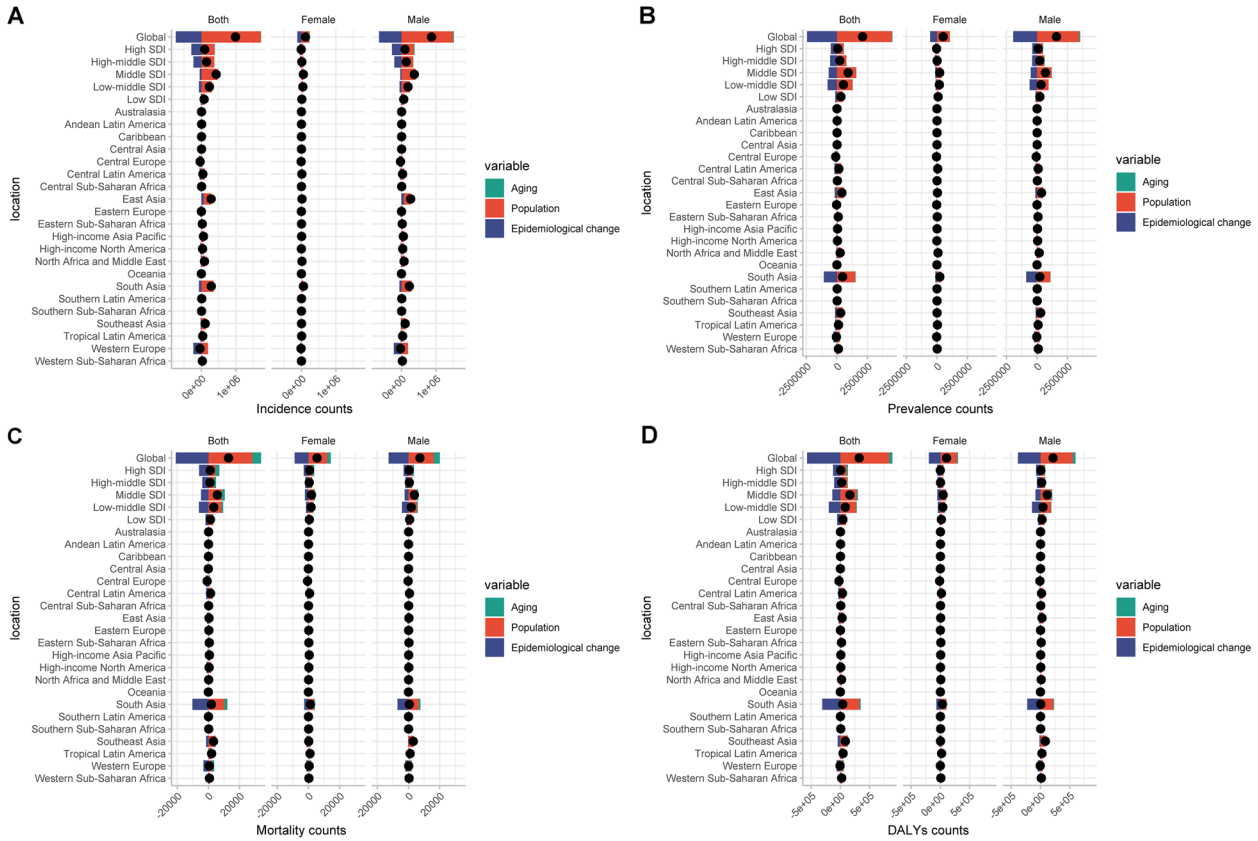

Fig. 8 Decomposition analysis of changes in inguinal, femoral, and abdominal hernia burden, 1990–2021. Stacked bar charts showing the results of decomposition analysis for changes in (**A**) incidence, **B** prevalence, **C** mortality, and **D** DALY rates from 1990 to 2021. Data are presented for global, five SDI regions, and 21 GBD regions, stratified by sex

(ASIR) was significantly positively correlated with the SDI ($R = 0.56$, $P < 0.001$), showing a continuous upward trend (Fig. 11A). In contrast, the age-standardized prevalence rate (ASPR) had a more complex relationship with the SDI, which peaked at an SDI of 0.6 and then began to decline ($R = -0.14$, $P = 0.04$) (Fig. 11B). Both age-standardized mortality rates (ASMR) and age-standardized death rates (ASDR) were significantly negatively correlated with the SDI, with $R = -0.31$ and $R = -0.33$ ($P < 0.001$), respectively, and both were on a downward trend (Fig. 11C, D). By 2021, these relationships changed significantly. The positive correlation between ASIR and SDI was slightly weakened ($R = 0.53$, $P < 0.001$) (Fig. 11E), while the negative correlation between ASPR and SDI was significantly strengthened ($R = -0.49$, $P < 0.001$) (Fig. 11F). The negative correlation between ASMR and ASDR and SDI was further strengthened, respectively, by $R = -0.54$ and $R = -0.58$ ($P < 0.001$) (Fig. 11G, H). The regional analysis for 1990–2021 (Fig. 12) revealed more details. The relationship between ASIR and SDI showed a nonlinear trend, peaking at SDI of 0.75 ($R = 0.38$, $P < 0.001$) (Fig. 12A). The burden of disease was much higher than expected in Western Europe and much lower in East Asia. ASPR, ASMR, and ASDR were all negatively correlated with the SDI, with $R = -0.52$, $R = -0.53$, and $R = -0.57$ ($P < 0.001$), respectively (Fig. 12B-D). ASPR was significantly higher than expected in Central America and Central Europe, while ASMR and ASDR were much higher than expected in Andean Latin America and South Asia. East Asia showed lower disease burden in all indicators. The country-level analysis (Fig. 13) further confirms these trends, while revealing significant differences between countries.

Frontier analysis of inguinal, femoral and abdominal hernia burden

The frontier analysis showed that the burden of disease differed significantly between countries (Fig. 14A-H). The results showed that the United Kingdom, Slovenia and Austria were the top three countries in terms of prevalence, with effective differences of 390.74, 223.67 and 210.87, respectively (Table 14). In contrast, Somalia, Papua New Guinea and Solomon Islands had the smallest effective variances of 0.70, 0.88 and 1.70, respectively.

Table 9 Decomposition analysis of changes in incidence of inguinal, femoral, and abdominal hernia by sex for global, SDI quintiles, and 21 GBD regions in population aged 45 years and above, 1990 - 2021

Location	Both				Male	
	Overll difference	Aging (percent change of Aging%)	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)	Overll difference	Aging (percent change of Aging%)
01 Global	988957.99	8739.576(0.884%)	1718839.346(173.803%)	− 738620.932(− 74.687%)	871356.356	26733.477(3.068%)
02 High SDI	98715.908	6162.894(6.243%)	380792.65(385.746%)	− 288239.636(− 291.989%)	104641.123	16298.908(15.576%)
03 High-middle SDI	149727.531	− 622.724(− 0.416%)	374485.725(250.111%)	− 224135.47(− 149.696%)	137753.179	6949.224(5.045%)
04 Middle SDI	428486.487	3096.117(0.723%)	472875.777(110.36%)	− 47485.407(− 11.082%)	372012.259	6183.828(1.662%)
05 Low-middle SDI	233060.077	2346.933(1.007%)	298021.473(127.873%)	− 67308.329(− 28.88%)	190484.923	1576.823(0.828%)
06 Low SDI	79188.98	− 1807.032(− 2.282%)	94199.633(118.955%)	− 13203.622(− 16.674%)	66613.388	− 2228.026(− 3.345%)
Andean Latin America	9003.56	42.75(0.475%)	13280.61(147.504%)	− 4319.801(− 47.979%)	6855.216	58.048(0.847%)
Australasia	5136.827	246.01(4.789%)	7889.714(153.591%)	− 2998.896(− 58.38%)	4172.029	429.388(10.292%)
Caribbean	5366.796	− 42.357(− 0.789%)	9469.205(176.441%)	− 4060.052(− 75.651%)	4235.861	− 21.071(− 0.497%)
Central Asia	5999.94	156.08(2.601%)	12100.522(201.677%)	− 6256.662(− 104.279%)	4856.334	123.481(2.543%)
Central Europe	− 34705.56	743.188(− 2.141%)	36345.868(− 104.726%)	− 71794.615(206.868%)	− 27603.889	2589.207(− 9.38%)
Central Latin America	44806.369	1107.78(2.472%)	97246.724(217.038%)	− 53548.135(− 119.51%)	32293.481	1095.312(3.392%)
Central Sub-Saharan Africa	7487.147	− 251.029(− 3.353%)	8416.453(112.412%)	− 678.276(− 9.059%)	6491.327	− 342.009(− 5.269%)
East Asia	282467.02	3479.12(1.232%)	216110.52(76.508%)	62877.381(22.26%)	265819.422	6370.947(2.397%)
Eastern Europe	1187.627	− 395.114(− 33.269%)	25840.757(2175.831%)	− 24258.016(− 2042.561%)	2282.876	3017.376(132.174%)
Eastern Sub-Saharan Africa	26494.174	− 832.81(− 3.143%)	25663.732(96.866%)	1663.253(6.278%)	22676.706	− 1018.73(− 4.492%)
High-income Asia Pacific	61481.443	2548.793(4.146%)	64098.29(104.256%)	− 5165.64(− 8.402%)	55409.273	5267.699(9.507%)
High-income North America	35150.231	1708.54(4.861%)	65658.408(186.794%)	− 32216.717(− 91.654%)	35869.049	2928.044(8.163%)
North Africa and Middle East	90703.783	− 1363.472(− 1.503%)	104797.861(115.539%)	− 12730.606(− 14.035%)	75482.693	− 2090.354(− 2.769%)
Oceania	753.295	− 19.322(− 2.565%)	869.929(115.483%)	− 97.311(− 12.918%)	703.709	− 13.296(− 1.889%)
South Asia	287669.009	5939.878(2.065%)	350129.562(121.713%)	− 68400.431(− 23.777%)	228671.521	4871.475(2.13%)
Southeast Asia	111173.695	1613.242(1.451%)	130163.123(117.081%)	− 20602.67(− 18.532%)	107097.311	1137.6(1.062%)
Southern Latin America	11224.375	− 89.857(− 0.801%)	11453.638(102.043%)	− 139.407(− 1.242%)	8868.984	36.851(0.416%)
Southern Sub-Saharan Africa	5719.817	28.475(0.498%)	6308.683(110.295%)	− 617.341(− 10.793%)	4295.409	− 10.564(− 0.246%)
Tropical Latin America	40556.184	299.973(0.74%)	69492.821(171.35%)	− 29236.609(− 72.089%)	33193.943	578.579(1.743%)
Western Europe	− 38436.51	− 4178.529(10.871%)	192616.328(− 501.129%)	− 226874.309(590.257%)	− 27313.976	4471.35(− 16.37%)
Western Sub-Saharan Africa	29718.767	− 964.162(− 3.244%)	34508.551(116.117%)	− 3825.621(− 12.873%)	26999.076	− 957.704(− 3.547%)

Table 9 (continued)

Loctaion			Female			
	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)	Overll difference	Aging (percent change of Aging%)	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)
01 Global	1490141.467(171.014%)	− 645518.588(− 74.082%)	117601.635	2095.78(1.782%)	232386.351(197.605%)	− 116880.496(− 99.387%)
02 High SDI	360219.654(344.243%)	− 271877.439(− 259.819%)	− 5925.215	1526.519(− 25.763%)	47522.391(− 802.037%)	− 54974.125(927.8%)
03 High-middle SDI	334561.93(242.871%)	− 203757.976(− 147.915%)	11974.351	228.138(1.905%)	53496.622(446.76%)	− 41750.409(− 348.665%)
04 Middle SDI	399186.262(107.305%)	− 33357.83(− 8.967%)	56474.227	293.266(0.519%)	61257.194(108.469%)	− 5076.232(− 8.989%)
05 Low-middle SDI	243629.047(127.899%)	− 54720.947(− 28.727%)	42575.154	499.346(1.173%)	40303.436(94.664%)	1772.372(4.163%)
06 Low SDI	79875.995(119.91%)	− 11034.581(− 16.565%)	12575.592	− 17.67(− 0.141%)	11514.182(91.56%)	1079.08(8.581%)
Andean Latin America	10471.914(152.758%)	− 3674.746(− 53.605%)	2148.343	− 2.948(− 0.137%)	2649.11(123.309%)	− 497.818(− 23.172%)
Australasia	6870.458(164.679%)	− 3127.816(− 74.971%)	964.798	35.87(3.718%)	1105.815(114.616%)	− 176.887(− 18.334%)
Caribbean	7666.843(180.998%)	− 3409.911(− 80.501%)	1130.934	− 14.823(− 1.311%)	1616.947(142.974%)	− 471.19(− 41.664%)
Central Asia	10187.996(209.788%)	− 5455.144(− 112.33%)	1143.606	87.914(7.687%)	2475.699(216.482%)	− 1420.008(− 124.169%)
Central Europe	32840.029(− 118.969%)	− 63033.125(228.349%)	− 7101.671	524.856(− 7.391%)	4935.407(− 69.496%)	− 12561.934(176.887%)
Central Latin America	73236.817(226.785%)	− 42038.648(− 130.177%)	12512.887	76.362(0.61%)	21194.862(169.384%)	− 8758.337(− 69.995%)
Central Sub-Saharan Africa	7655.902(117.94%)	− 822.566(− 12.672%)	995.82	− 0.663(− 0.067%)	946.601(95.057%)	49.883(5.009%)
East Asia	195604.001(73.585%)	63844.473(24.018%)	16647.598	465.471(2.796%)	14908.909(89.556%)	1273.218(7.648%)
Eastern Europe	25425.366(1113.743%)	− 26159.866(− 1145.917%)	− 1095.249	32.946(− 3.008%)	4742.39(− 432.997%)	− 5870.585(536.005%)
Eastern Sub-Saharan Africa	21653.413(95.487%)	2042.024(9.005%)	3817.468	− 33.626(− 0.881%)	3411.918(89.376%)	439.177(11.504%)
High-income Asia Pacific	58923.51(106.342%)	− 8781.937(− 15.849%)	6072.17	1895.665(31.219%)	7370.837(121.387%)	− 3194.332(− 52.606%)
High-income North America	62387.132(173.93%)	− 29446.127(− 82.093%)	− 718.818	− 141.301(19.657%)	7409.233(− 1030.752%)	− 7986.751(1111.094%)
North Africa and Middle East	90776.54(120.261%)	− 13203.494(− 17.492%)	15221.09	71.472(0.47%)	15150.132(99.534%)	− 0.514(− 0.003%)
Oceania	802.983(114.107%)	− 85.979(− 12.218%)	49.587	− 1.938(− 3.908%)	64.015(129.097%)	− 12.491(− 25.189%)
South Asia	281325.122(123.026%)	− 57525.076(− 25.156%)	58997.488	1262.313(2.14%)	49097.865(83.22%)	8637.31(14.64%)
Southeast Asia	122021.188(113.935%)	− 16061.477(− 14.997%)	4076.385	171.313(4.203%)	8681.257(212.965%)	− 4776.186(− 117.167%)
Southern Latin America	9372.838(105.681%)	− 540.706(− 6.097%)	2355.391	16.681(0.708%)	2056.641(87.316%)	282.068(11.975%)
Southern Sub-Saharan Africa	4920.448(114.551%)	− 614.475(− 14.305%)	1424.409	− 0.949(− 0.067%)	1292.864(90.765%)	132.494(9.302%)
Tropical Latin America	56526.482(170.292%)	− 23911.119(− 72.035%)	7362.242	12.931(0.176%)	11188.463(151.971%)	− 3839.152(− 52.147%)
Western Europe	187452.331(− 686.287%)	− 219237.657(802.657%)	− 11122.535	59.396(− 0.534%)	24262.077(− 218.134%)	− 35444.007(318.668%)
Western Sub-Saharan Africa	27905.958(103.359%)	50.822(0.188%)	2719.691	− 24.998(− 0.919%)	2585.931(95.082%)	158.758(5.837%)

Table 10 Decomposition analysis of changes in prevalence of inguinal, femoral, and abdominal hernia by sex for global, SDI quintiles, and 21 GBD regions in population aged 45 years and above, 1990–2021

Location	Both				Male	
	Overll difference	Aging (percent change of Aging%)	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)	Overll difference	Aging (percent change of Aging%)
01 Global	2104588.683	45688.019(2.171%)	4492360.654(213.456%)	− 2433459.99(− 115.626%)	1595855.525	88268.133(5.531%)
02 High SDI	79093.858	26981.008(34.113%)	542037.532(685.309%)	− 489924.683(− 619.422%)	105562.388	35758.275(33.874%)
03 High-middle SDI	239239.332	12558.595(5.249%)	772903.333(323.067%)	− 546222.596(− 228.316%)	224760.592	25390.528(11.297%)
04 Middle SDI	920933.043	21707.062(2.357%)	1563024.012(169.722%)	− 663798.031(− 72.079%)	694559.387	31457.341(4.529%)
05 Low-middle SDI	533219.125	17168.615(3.22%)	1270769.331(238.32%)	− 754718.821(− 141.54%)	333669.655	12574.852(3.769%)
06 Low SDI	332383.259	− 6521.44(− 1.962%)	471777.763(141.938%)	− 132873.064(− 39.976%)	237317.885	− 7939.328(− 3.345%)
Andean Latin America	25077.767	166.855(0.665%)	53035.496(211.484%)	− 28124.584(− 112.149%)	14023.47	275.452(1.964%)
Australasia	7058.927	898.022(12.722%)	15801.476(223.851%)	− 9640.57(− 136.573%)	5089.436	1312.63(25.791%)
Caribbean	17629.155	− 301.175(− 1.708%)	35334.576(200.433%)	− 17404.246(− 98.724%)	10981.471	− 142.421(− 1.297%)
Central Asia	20599.202	487.466(2.366%)	40942.806(198.759%)	− 20831.069(− 101.126%)	13725.82	582.19(4.242%)
Central Europe	− 96941.225	10233.939(− 10.557%)	72421.459(− 74.707%)	− 179596.623(185.263%)	− 61214.569	10294.5(− 16.817%)
Central Latin America	162643.279	5672.042(3.487%)	350485.882(215.494%)	− 193514.645(− 118.981%)	99306.669	4434.623(4.466%)
Central Sub-Saharan Africa	40086.742	− 1115.864(− 2.784%)	40778.914(101.727%)	423.693(1.057%)	30339.224	− 1704.98(− 5.62%)
East Asia	410426.497	13545.983(3.3%)	563353.94(137.261%)	− 166473.426(− 40.561%)	368186.407	20962.152(5.693%)
Eastern Europe	− 20745.101	6069.996(− 29.26%)	55532.052(− 267.688%)	− 82347.15(396.947%)	1625.27	11032.616(678.817%)
Eastern Sub-Saharan Africa	111982.029	− 4417.975(− 3.945%)	124028.38(110.757%)	− 7628.376(− 6.812%)	83607.498	− 5025.347(− 6.011%)
High-income Asia Pacific	54486.751	14761.923(27.093%)	94856.23(174.09%)	− 55131.402(− 101.183%)	43280.568	13035.842(30.119%)
High-income North America	48186.11	3243.95(6.732%)	109324.075(226.879%)	− 64381.915(− 133.611%)	53236.809	5337.91(10.027%)
North Africa and Middle East	271180.656	− 294.077(− 0.108%)	301823.415(111.3%)	− 30348.683(− 11.191%)	182901.742	− 2213.669(− 1.21%)
Oceania	3224.171	− 71.709(− 2.224%)	3813.848(118.289%)	− 517.967(− 16.065%)	2837.749	− 44.349(− 1.563%)
South Asia	468800.382	39387.395(8.402%)	1497282.446(319.386%)	− 1067869.46(− 227.788%)	232624.22	31386.117(13.492%)
Southeast Asia	313654.419	7363.744(2.348%)	452283.934(144.198%)	− 145993.259(− 46.546%)	303205.52	4225.226(1.394%)
Southern Latin America	24879.149	321.643(1.293%)	34762.643(139.726%)	− 10205.137(− 41.019%)	17398.209	529.15(3.041%)
Southern Sub-Saharan Africa	24681.161	39.087(0.158%)	30564.191(123.836%)	− 5922.116(− 23.994%)	14819.951	− 190.214(− 1.283%)
Tropical Latin America	134071.093	3927.938(2.93%)	276711.45(206.392%)	− 146568.294(− 109.321%)	94339.173	4456.523(4.724%)
Western Europe	− 42038.267	8877.693(− 21.118%)	236650.968(− 562.942%)	− 287566.928(684.06%)	− 18887.079	17500.647(− 92.659%)
Western Sub-Saharan Africa	125645.787	− 5256.807(− 4.184%)	161806.69(128.78%)	− 30904.096(− 24.596%)	104427.966	− 3709.405(− 3.552%)

Table 10 (continued)

Loctaion			Female			
	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)	Overll difference	Aging (percent change of Aging%)	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)
01 Global	3449612.29(216.161%)	− 1942024.898(− 121.692%)	508733.158	6698.096(1.317%)	1051727.402(206.735%)	− 549692.34(− 108.051%)
02 High SDI	452023.676(428.205%)	− 382219.564(− 362.079%)	− 26468.53	8072.623(− 30.499%)	119247.057(− 450.524%)	− 153788.21(581.023%)
03 High-middle SDI	594266.146(264.4%)	− 394896.081(− 175.696%)	14478.74	2203.887(15.222%)	198386.957(1370.195%)	− 186112.104(− 1285.416%)
04 Middle SDI	1168468.739(168.232%)	− 505366.693(− 72.761%)	226373.656	1149.42(0.508%)	362981.611(160.346%)	− 137757.376(− 60.854%)
05 Low-middle SDI	923727.477(276.839%)	− 602632.673(− 180.608%)	199549.47	1769.279(0.887%)	299044.729(149.86%)	− 101264.537(− 50.747%)
06 Low SDI	358214.093(150.943%)	− 112956.879(− 47.597%)	95065.374	− 394.059(− 0.415%)	102500.617(107.821%)	− 7041.184(− 7.407%)
Andean Latin America	35042.731(249.886%)	− 21294.713(− 151.851%)	11054.297	− 84.307(− 0.763%)	17588.491(159.11%)	− 6449.887(− 58.347%)
Australasia	12721.096(249.951%)	− 8944.29(− 175.742%)	1969.491	149.718(7.602%)	3262.047(165.629%)	− 1442.274(− 73.231%)
Caribbean	24536.331(223.434%)	− 13412.438(− 122.137%)	6647.684	− 156.907(− 2.36%)	10331.417(155.414%)	− 3526.826(− 53.053%)
Central Asia	26555.569(193.472%)	− 13411.94(− 97.713%)	6873.382	421.429(6.131%)	15286.141(222.396%)	− 8834.188(− 128.528%)
Central Europe	56092.723(− 91.633%)	− 127601.792(208.45%)	− 35726.657	3386.162(− 9.478%)	18344.137(− 51.346%)	− 57456.956(160.824%)
Central Latin America	215950.986(217.459%)	− 121078.939(− 121.924%)	63336.61	1024.176(1.617%)	129063.332(203.774%)	− 66750.899(− 105.391%)
Central Sub-Saharan Africa	33293.473(109.737%)	− 1249.269(− 4.118%)	9747.518	− 22.456(− 0.23%)	8178.413(83.903%)	1591.561(16.328%)
East Asia	480275.003(130.443%)	− 133050.748(− 36.137%)	42240.09	1630.069(3.859%)	69886.518(165.451%)	− 29276.498(− 69.31%)
Eastern Europe	42567.169(2619.083%)	− 51974.515(− 3197.9%)	− 22370.371	1249.224(− 5.584%)	18054.622(− 80.708%)	− 41674.217(186.292%)
Eastern Sub-Saharan Africa	93745.473(112.126%)	− 5112.628(− 6.115%)	28374.531	− 519.249(− 1.83%)	27978.852(98.606%)	914.929(3.224%)
High-income Asia Pacific	78186.908(180.651%)	− 47942.182(− 110.771%)	11206.183	7401.05(66.044%)	19470.787(173.75%)	− 15665.654(− 139.795%)
High-income North America	93929.471(176.437%)	− 46030.572(− 86.464%)	− 5050.699	− 73.389(1.453%)	20956.749(− 414.928%)	− 25934.059(513.475%)
North Africa and Middle East	203560.586(111.295%)	− 18445.175(− 10.085%)	88278.913	603.048(0.683%)	99659.707(112.892%)	− 11983.842(− 13.575%)
Oceania	3318.215(116.931%)	− 436.117(− 15.368%)	386.423	− 13.477(− 3.488%)	484.657(125.421%)	− 84.758(− 21.934%)
South Asia	1073712.325(461.565%)	− 872474.223(− 375.057%)	236176.161	6028.713(2.553%)	353579.604(149.71%)	− 123432.156(− 52.263%)
Southeast Asia	403124.029(132.954%)	− 104143.736(− 34.348%)	10448.899	1301.214(12.453%)	50906.148(487.192%)	− 41758.463(− 399.645%)
Southern Latin America	24491.055(140.768%)	− 7621.995(− 43.809%)	7480.94	96.363(1.288%)	10225.57(136.688%)	− 2840.993(− 37.976%)
Southern Sub-Saharan Africa	19445.145(131.209%)	− 4434.98(− 29.926%)	9861.21	21.609(0.219%)	10842.091(109.947%)	− 1002.489(− 10.166%)
Tropical Latin America	194428.463(206.095%)	− 104545.813(− 110.819%)	39731.92	− 53.562(− 0.135%)	77265.033(194.466%)	− 37479.551(− 94.331%)
Western Europe	202036.609(− 1069.708%)	− 238424.335(1262.367%)	− 23151.188	3169.521(− 13.691%)	52221.515(− 225.567%)	− 78542.224(339.258%)
Western Sub-Saharan Africa	122392.051(117.202%)	− 14254.68(− 13.65%)	21217.82	− 167.775(− 0.791%)	22915.597(108.002%)	− 1530.001(− 7.211%)

Table 11 Decomposition analysis of changes in DALYs due to inguinal, femoral, and abdominal hernia by sex for global, SDI quintiles, and 21 GBD regions in population aged 45 years and above, 1990–2021

Location	Both				Male	
	Overll difference	Aging (percent change of Aging%)	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)	Overll difference	Aging (percent change of Aging%)
01 Global	321629.411	54209.869(16.855%)	835200.935(259.678%)	− 567781.393(− 176.533%)	216078.409	44280.382(20.493%)
02 High SDI	6064.73	24398.635(402.304%)	104215.002(1718.378%)	− 122548.907(− 2020.682%)	7618.796	15608.627(204.87%)
03 High-middle SDI	23183.279	11264.447(48.589%)	115679.836(498.98%)	− 103761.003(− 447.568%)	20842.647	8556.267(41.052%)
04 Middle SDI	163685.328	19546.391(11.941%)	280510.676(171.372%)	− 136371.739(− 83.313%)	116464.567	14169.932(12.167%)
05 Low-middle SDI	84581.287	13025.792(15.4%)	266065.921(314.568%)	− 194510.426(− 229.969%)	43266.519	7044.926(16.283%)
06 Low SDI	44229.938	− 498.638(− 1.127%)	97654.982(220.789%)	− 52926.407(− 119.662%)	27829.618	− 986.901(− 3.546%)
Andean Latin America	3884.653	274.889(7.076%)	8715.065(224.346%)	− 5105.302(− 131.422%)	1916.993	147.118(7.674%)
Australasia	2244.748	624.375(27.815%)	3188.745(142.054%)	− 1568.372(− 69.869%)	1182.758	493.144(41.694%)
Caribbean	2923.26	328.8(11.248%)	7504.346(256.712%)	− 4909.886(− 167.959%)	1969.091	113.693(5.774%)
Central Asia	948.057	− 196.615(− 20.739%)	5388.256(568.347%)	− 4243.583(− 447.609%)	1368.544	12.861(0.94%)
Central Europe	− 21914.449	5663.033(− 25.842%)	11517.63(− 52.557%)	− 39095.112(178.399%)	− 8743.183	2745.093(− 31.397%)
Central Latin America	36609.085	4107.601(11.22%)	68238.073(186.397%)	− 35736.588(− 97.617%)	18640.681	1766.299(9.476%)
Central Sub-Saharan Africa	7154.353	− 295.091(− 4.125%)	8027.285(112.201%)	− 577.841(− 8.077%)	4837.806	− 573.469(− 11.854%)
East Asia	30797.901	5068.826(16.458%)	53379.231(173.321%)	− 27650.155(− 89.779%)	26602.204	4940.91(18.573%)
Eastern Europe	1871.095	3184.86(170.214%)	8606.993(459.998%)	− 9920.759(− 530.211%)	1746.204	1974.707(113.086%)
Eastern Sub-Saharan Africa	19867.649	− 858.385(− 4.321%)	25933.34(130.53%)	− 5207.306(− 26.21%)	12447.005	− 1067.627(− 8.577%)
High-income Asia Pacific	8537.024	7110.145(83.286%)	11886.045(139.229%)	− 10459.166(− 122.515%)	3674.003	2963.319(80.656%)
High-income North America	7780.858	2141.056(27.517%)	31422.604(403.845%)	− 25782.802(− 331.362%)	5829.501	2247.68(38.557%)
North Africa and Middle East	20578.209	− 47.627(− 0.231%)	28622.391(139.091%)	− 7996.556(− 38.859%)	13277.582	− 194.583(− 1.466%)
Oceania	356.573	− 3.308(− 0.928%)	427.727(119.955%)	− 67.846(− 19.027%)	333.577	− 0.361(− 0.108%)
South Asia	41115.418	23710.978(57.669%)	324531.528(789.318%)	− 307127.089(− 746.988%)	6015.642	14600.49(242.709%)
Southeast Asia	85311.157	3939.485(4.618%)	124772.642(146.256%)	− 43400.97(− 50.874%)	83639.592	1599.432(1.912%)
Southern Latin America	1642.683	892.014(54.302%)	7542.711(459.17%)	− 6792.042(− 413.472%)	1274.471	407.52(31.976%)
Southern Sub-Saharan Africa	6965.844	− 106.806(− 1.533%)	6899.642(99.05%)	173.007(2.484%)	3247.672	− 109.247(− 3.364%)
Tropical Latin America	46619.378	3751.301(8.047%)	49284.107(105.716%)	− 6416.03(− 13.763%)	26030.252	1950.507(7.493%)
Western Europe	− 4432.9	15621.911(− 352.408%)	44107.812(− 995.01%)	− 64162.622(1447.419%)	− 4031.232	10953.294(− 271.711%)
Western Sub-Saharan Africa	22768.814	− 1985.133(− 8.719%)	28227.68(123.975%)	− 3473.732(− 15.257%)	14819.248	− 570.647(− 3.851%)

Table 11 (continued)

Loctaion			Female			
	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)	Overll difference	Aging (percent change of Aging%)	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)
01 Global	555728.615(257.188%)	− 383930.588(− 177.681%)	105551.002	19818.316(18.776%)	280911.303(266.138%)	− 195178.618(− 184.914%)
02 High SDI	64929.533(852.228%)	− 72919.363(− 957.098%)	− 1554.066	11787.652(− 758.504%)	41492.677(− 2669.943%)	− 54834.395(3528.447%)
03 High-middle SDI	72961.731(350.06%)	− 60675.351(− 291.112%)	2340.632	4724.708(201.856%)	44322.165(1893.598%)	− 46706.241(− 1995.454%)
04 Middle SDI	184815.893(158.689%)	− 82521.257(− 70.855%)	47220.761	6964.614(14.749%)	91947.944(194.719%)	− 51691.797(− 109.468%)
05 Low-middle SDI	178972.867(413.652%)	− 142751.275(− 329.935%)	41314.768	4876.784(11.804%)	78907.704(190.992%)	− 42469.72(− 102.795%)
06 Low SDI	67055.478(240.95%)	− 38238.959(− 137.404%)	16400.32	176.213(1.074%)	28847.165(175.894%)	− 12623.058(− 76.968%)
Andean Latin America	5286.022(275.746%)	− 3516.147(− 183.42%)	1967.66	127.576(6.484%)	3380.654(171.811%)	− 1540.571(− 78.295%)
Australasia	1954.152(165.22%)	− 1264.538(− 106.914%)	1061.99	213.07(20.063%)	1255.513(118.223%)	− 406.593(− 38.286%)
Caribbean	4444.735(225.725%)	− 2589.337(− 131.499%)	954.169	204.272(21.408%)	3006.825(315.125%)	− 2256.928(− 236.533%)
Central Asia	2833.013(207.009%)	− 1477.33(− 107.949%)	− 420.487	− 164.155(39.039%)	2577.29(− 612.93%)	− 2833.622(673.89%)
Central Europe	6761.142(− 77.33%)	− 18249.419(208.727%)	− 13171.266	3185.195(− 24.183%)	4871.803(− 36.988%)	− 21228.264(161.171%)
Central Latin America	34859.26(187.006%)	− 17984.877(− 96.482%)	17968.404	2299.29(12.796%)	33023.236(183.785%)	− 17354.121(− 96.581%)
Central Sub-Saharan Africa	6072.071(125.513%)	− 660.796(− 13.659%)	2316.547	64.714(2.794%)	2067.71(89.258%)	184.123(7.948%)
East Asia	42846.282(161.063%)	− 21184.989(− 79.636%)	4195.698	1267.144(30.201%)	9522.349(226.955%)	− 6593.795(− 157.156%)
Eastern Europe	5040.902(288.678%)	− 5269.405(− 301.763%)	124.891	1715.864(1373.89%)	3806.902(3048.181%)	− 5397.874(− 4322.07%)
Eastern Sub-Saharan Africa	17158.004(137.848%)	− 3643.373(− 29.271%)	7420.644	− 19.62(− 0.264%)	8433.601(113.651%)	− 993.337(− 13.386%)
High-income Asia Pacific	7790.401(212.041%)	− 7079.716(− 192.698%)	4863.021	4631.006(95.229%)	4287.477(88.165%)	− 4055.462(− 83.394%)
High-income North America	18673.236(320.323%)	− 15091.415(− 258.88%)	1951.357	361.968(18.55%)	13222.657(677.613%)	− 11633.268(− 596.163%)
North Africa and Middle East	18260.639(137.53%)	− 4788.474(− 36.064%)	7300.627	60.763(0.832%)	10467.168(143.374%)	− 3227.304(− 44.206%)
Oceania	378.736(113.538%)	− 44.798(− 13.43%)	22.995	− 1.233(− 5.361%)	47.674(207.318%)	− 23.445(− 101.956%)
South Asia	216024.194(3591.042%)	− 224609.042(− 3733.75%)	35099.776	7884.088(22.462%)	96058.776(273.673%)	− 68843.088(− 196.135%)
Southeast Asia	97509.032(116.582%)	− 15468.873(− 18.495%)	1671.565	1737.124(103.922%)	27658.466(1654.645%)	− 27724.026(− 1658.567%)
Southern Latin America	4092.269(321.096%)	− 3225.318(− 253.071%)	368.212	509.069(138.254%)	3447.05(936.158%)	− 3587.907(− 974.413%)
Southern Sub-Saharan Africa	3838.909(118.205%)	− 481.99(− 14.841%)	3718.173	− 33.367(− 0.897%)	3020.502(81.236%)	731.038(19.661%)
Tropical Latin America	29232.487(112.302%)	− 5152.742(− 19.795%)	20589.127	1802.207(8.753%)	19570.128(95.051%)	− 783.208(− 3.804%)
Western Europe	29004.558(− 719.496%)	− 43989.083(1091.207%)	− 401.668	7228.086(− 1799.517%)	16622.923(− 4138.473%)	− 24252.677(6037.991%)
Western Sub-Saharan Africa	17776.674(119.957%)	− 2386.779(− 16.106%)	7949.566	− 1203.183(− 15.135%)	8715.091(109.63%)	437.659(5.505%)

Table 12 Decomposition analysis of changes in mortality of inguinal, femoral, and abdominal hernia by sex for global, SDI quintiles, and 21 GBD regions in population aged 45 years and above, 1990–2021

Location	Both				Male	
	Overll difference	Aging (percent change of Aging%)	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)	Overll difference	Aging (percent change of Aging%)
01 Global	12915.515	5534.548(42.852%)	28226.166(218.545%)	− 20845.199(− 161.397%)	7360.517	3806.553(51.716%)
02 High SDI	1229.487	2432.458(197.843%)	4661.875(379.172%)	− 5864.846(− 477.016%)	462.801	1316.652(284.496%)
03 High-middle SDI	1066.637	1141.293(106.999%)	3714.642(348.257%)	− 3789.297(− 355.256%)	551.122	684.649(124.228%)
04 Middle SDI	5773.828	1760.082(30.484%)	8687.075(150.456%)	− 4673.328(− 80.94%)	3791.495	1113.78(29.376%)
05 Low-middle SDI	3505.705	1082.085(30.866%)	8445.16(240.898%)	− 6021.54(− 171.764%)	1785.463	566.633(31.736%)
06 Low SDI	1343.333	97.76(7.277%)	3007.324(223.87%)	− 1761.751(− 131.148%)	766.302	43.299(5.65%)
Andean Latin America	132.105	25.25(19.114%)	253.79(192.113%)	− 146.935(− 111.227%)	58.308	11.927(20.456%)
Australasia	162.008	60.898(37.59%)	147.397(90.981%)	− 46.287(− 28.571%)	75.13	41.304(54.977%)
Caribbean	110.484	44.002(39.827%)	264.781(239.654%)	− 198.298(− 179.481%)	68.776	16.586(24.116%)
Central Asia	− 12.566	− 19.606(156.022%)	120.416(− 958.237%)	− 113.376(902.215%)	23.266	− 3.962(− 17.03%)
Central Europe	− 767.007	483.039(− 62.977%)	411.849(− 53.696%)	− 1661.896(216.673%)	− 217.489	190.092(− 87.403%)
Central Latin America	1412.653	352.95(24.985%)	2360.974(167.13%)	− 1301.271(− 92.115%)	643.404	134.209(20.859%)
Central Sub-Saharan Africa	201.552	− 4.359(− 2.163%)	232.978(115.592%)	− 27.067(− 13.429%)	117.731	− 26.322(− 22.358%)
East Asia	433.976	407.997(94.014%)	927.918(213.818%)	− 901.939(− 207.831%)	301.748	338.554(112.197%)
Eastern Europe	323.751	282.758(87.338%)	268.723(83.003%)	− 227.729(− 70.341%)	116.013	114.912(99.051%)
Eastern Sub-Saharan Africa	597.719	− 8.003(− 1.339%)	796.723(133.294%)	− 191(− 31.955%)	314.423	− 31.847(− 10.129%)
High-income Asia Pacific	671.505	655.181(97.569%)	431.874(64.314%)	− 415.549(− 61.883%)	147.089	209.589(142.491%)
High-income North America	492.478	196.972(39.996%)	1525.926(309.847%)	− 1230.42(− 249.843%)	216.258	181.463(83.91%)
North Africa and Middle East	185.659	8(4.309%)	431.727(232.537%)	− 254.068(− 136.846%)	82.369	3.618(4.392%)
Oceania	6.355	0.172(2.712%)	7.509(118.164%)	− 1.327(− 20.876%)	6.51	0.22(3.373%)
South Asia	1957.685	1816.046(92.765%)	10333.949(527.866%)	− 10192.31(− 520.631%)	629.765	1047.7(166.364%)
Southeast Asia	3295.03	272.674(8.275%)	4462.061(135.418%)	− 1439.705(− 43.693%)	3086.816	103.646(3.358%)
Southern Latin America	64.631	94.849(146.755%)	292.477(452.535%)	− 322.695(− 499.29%)	31.138	38.117(122.414%)
Southern Sub-Saharan Africa	227.606	− 13.233(− 5.814%)	216.247(95.009%)	24.592(10.805%)	90.309	− 10.288(− 11.392%)
Tropical Latin America	2102.103	340.211(16.184%)	1549.565(73.715%)	212.327(10.101%)	1065.349	158.32(14.861%)
Western Europe	612.211	1678.584(274.184%)	2043.103(333.725%)	− 3109.476(− 507.909%)	118.457	1006.436(849.623%)
Western Sub-Saharan Africa	705.576	− 100.273(− 14.212%)	852.49(120.822%)	− 46.641(− 6.61%)	385.147	− 3.132(− 0.813%)

Table 12 (continued)

Loctaion			Female			
	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)	Overll difference	Aging (percent change of Aging%)	Population (percent change of Population%)	Epidemiological change (percent change of Epidemiological change%)
01 Global	16215.608(220.305%)	− 12661.643(− 172.021%)	5554.998	2289.663(41.218%)	12074.36(217.36%)	− 8809.025(− 158.578%)
02 High SDI	2214.993(478.606%)	− 3068.843(− 663.102%)	766.686	1298.321(169.342%)	2444.479(318.837%)	− 2976.115(− 388.179%)
03 High-middle SDI	1839.719(333.813%)	− 1973.246(− 358.041%)	515.515	549.96(106.682%)	1888.302(366.294%)	− 1922.746(− 372.976%)
04 Middle SDI	5076.944(133.903%)	− 2399.228(− 63.279%)	1982.333	699.056(35.264%)	3544.184(178.789%)	− 2260.907(− 114.053%)
05 Low-middle SDI	5386.429(301.682%)	− 4167.599(− 233.418%)	1720.242	427.361(24.843%)	2837.328(164.938%)	− 1544.447(− 89.781%)
06 Low SDI	1940.142(253.182%)	− 1217.139(− 158.833%)	577.031	44.293(7.676%)	1023.392(177.355%)	− 490.654(− 85.031%)
Andean Latin America	137.874(236.459%)	− 91.494(− 156.915%)	73.797	12.971(17.577%)	115.093(155.96%)	− 54.268(− 73.537%)
Australasia	71.586(95.283%)	− 37.761(− 50.26%)	86.878	24.18(27.832%)	76.508(88.064%)	− 13.811(− 15.897%)
Caribbean	140.174(203.812%)	− 87.984(− 127.929%)	41.708	26.209(62.839%)	123.68(296.536%)	− 108.181(− 259.375%)
Central Asia	47.862(205.713%)	− 20.634(− 88.684%)	− 35.833	− 14.846(41.432%)	70.769(− 197.497%)	− 91.756(256.065%)
Central Europe	181.077(− 83.258%)	− 588.658(270.661%)	− 549.518	296.154(− 53.893%)	229.33(− 41.733%)	− 1075.002(195.626%)
Central Latin America	1061.731(165.018%)	− 552.536(− 85.877%)	769.25	215.264(27.984%)	1300.803(169.1%)	− 746.817(− 97.084%)
Central Sub-Saharan Africa	165.282(140.389%)	− 21.229(− 18.031%)	83.821	8.88(10.594%)	70.258(83.819%)	4.683(5.587%)
East Asia	639.182(211.826%)	− 675.988(− 224.024%)	132.228	115.932(87.676%)	283.881(214.69%)	− 267.585(− 202.366%)
Eastern Europe	106.777(92.038%)	− 105.676(− 91.089%)	207.738	179.24(86.281%)	151.889(73.116%)	− 123.391(− 59.397%)
Eastern Sub-Saharan Africa	483.807(153.871%)	− 137.537(− 43.743%)	283.296	13.412(4.734%)	304.739(107.569%)	− 34.855(− 12.303%)
High-income Asia Pacific	169.732(115.394%)	− 232.232(− 157.885%)	524.416	453.351(86.449%)	260.227(49.622%)	− 189.162(− 36.071%)
High-income North America	726.353(335.873%)	− 691.558(− 319.783%)	276.219	51.177(18.528%)	799.09(289.295%)	− 574.048(− 207.823%)
North Africa and Middle East	237.413(288.23%)	− 158.662(− 192.622%)	103.29	4.54(4.396%)	195.06(188.847%)	− 96.31(− 93.242%)
Oceania	6.808(104.578%)	− 0.518(− 7.952%)	− 0.155	− 0.006(4.063%)	0.676(− 435.197%)	− 0.825(531.134%)
South Asia	6577.02(1044.361%)	− 6994.955(− 1110.724%)	1327.92	645.867(48.638%)	3408.154(256.654%)	− 2726.102(− 205.291%)
Southeast Asia	3189.732(103.334%)	− 206.563(− 6.692%)	208.214	129.875(62.376%)	1285.784(617.529%)	− 1207.445(− 579.905%)
Southern Latin America	132.038(424.041%)	− 139.017(− 446.455%)	33.493	56.826(169.668%)	160.461(479.091%)	− 183.795(− 548.758%)
Southern Sub-Saharan Africa	106.542(117.976%)	− 5.946(− 6.584%)	137.297	− 4.893(− 3.564%)	109.01(79.397%)	33.18(24.166%)
Tropical Latin America	797.207(74.831%)	109.822(10.309%)	1036.755	177.267(17.098%)	746.16(71.971%)	113.328(10.931%)
Western Europe	1052.951(888.89%)	− 1940.931(− 1638.513%)	493.755	843.383(170.81%)	1004.359(203.413%)	− 1353.988(− 274.223%)
Western Sub-Saharan Africa	456.804(118.605%)	− 68.525(− 17.792%)	320.43	− 82.428(− 25.724%)	370.044(115.484%)	32.814(10.241%)

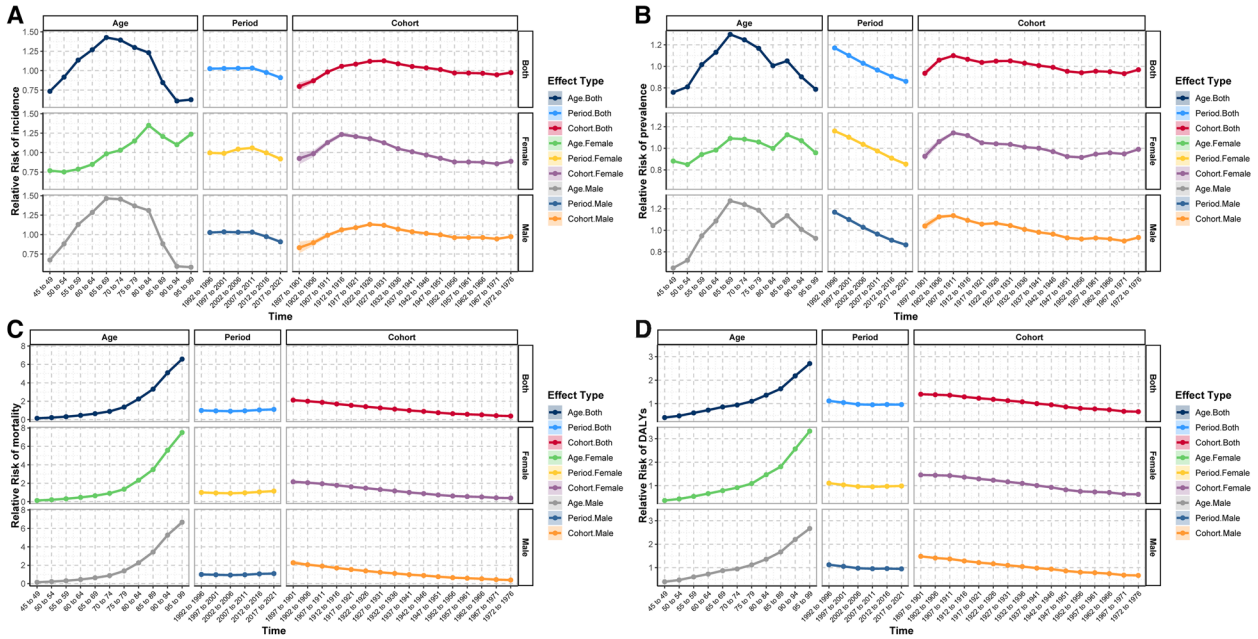

Fig. 9 Age-period-cohort (APC) analysis of global inguinal, femoral, and abdominal hernia burden, 1990–2021. Line graphs depicting the results of APC analysis for global (**A**) incidence, **B** prevalence, **C** mortality, and **D** DALY rates from 1990 to 2021. Data are presented separately for both sexes combined, males, and females

In terms of prevalence, Honduras, Mexico and Indonesia ranked in the top three, with effective variances as high as 617.54, 535.96 and 482.90, respectively (Table 15). In contrast, the Democratic People's Republic of Korea, Mauritius, and Somalia had the smallest effective variances of 2.55, 6.06, and 8.80, respectively. In terms of DALYs, Guatemala, Indonesia, and Paraguay had the highest burden, with effective variances of 207.61, 199.90, and 198.94, respectively (Table 16). Somalia, the Democratic People's Republic of Korea, and China had the smallest effective variances of 0, 0.26, and 0.26, respectively. For mortality, Indonesia, Guatemala, and Paraguay ranked in the top three with effective variances of 10.30, 10.03, and 9.91, respectively (Table 17). In contrast, Somalia, Northern Mariana Islands, and Jordan have the smallest effective variances with 0, 0.03, and 0.07, respectively. It is noteworthy that Somalia exhibits the smallest effective variances across multiple indicators, which may be related to its lower SDI. In contrast, some high-income countries, such as Switzerland and Norway, showed higher effective variances for some indicators, reflecting the complex relationship between the burden of disease and the level of socioeconomic development.

Association between health workforce distribution and hernia disease burden

The correlation analysis between health workforce distribution and hernia disease burden reveals significant temporal changes from 1990 to 2019. In 1990, pharmaceutical personnel demonstrated the strongest negative correlation with DALYs ($r = -0.39$, $p < 0.001$) and deaths ($r = -0.34$, $p < 0.001$) attributed to inguinal, femoral, and abdominal hernia. Similarly, pharmaceutical technicians showed comparable negative correlations with DALYs ($r = -0.34$, $p < 0.001$) and deaths ($r = -0.29$, $p < 0.001$). By 2019, these negative correlations strengthened substantially across multiple burden indicators, with pharmaceutical personnel exhibiting stronger negative correlations with DALYs ($r = -0.57$, $p < 0.001$), deaths ($r = -0.51$, $p < 0.001$), and prevalence ($r = -0.55$, $p < 0.001$). Dentistry personnel also showed notable increases in negative correlation strength from 1990 to 2019, with DALYs correlation strengthening from $r = -0.26$ ($p < 0.001$) to $r = -0.47$ ($p < 0.001$), and prevalence correlation strengthening from $r = -0.10$ ($p = 0.16$) to $r = -0.41$ ($p < 0.001$). Interestingly, while most health workforce categories demonstrated negative correlations with disease burden indicators, traditional and complementary practitioners consistently showed positive correlations with death rates in both 1990 ($r = 0.25$, $p < 0.001$) and 2019 ($r = 0.35$, $p < 0.001$), suggesting potential implications for healthcare system planning and resource allocation.

Examination of countries with extreme values reveals striking disparities in both health workforce distribution and hernia disease burden. In 2019, countries with the highest DALYs and deaths from

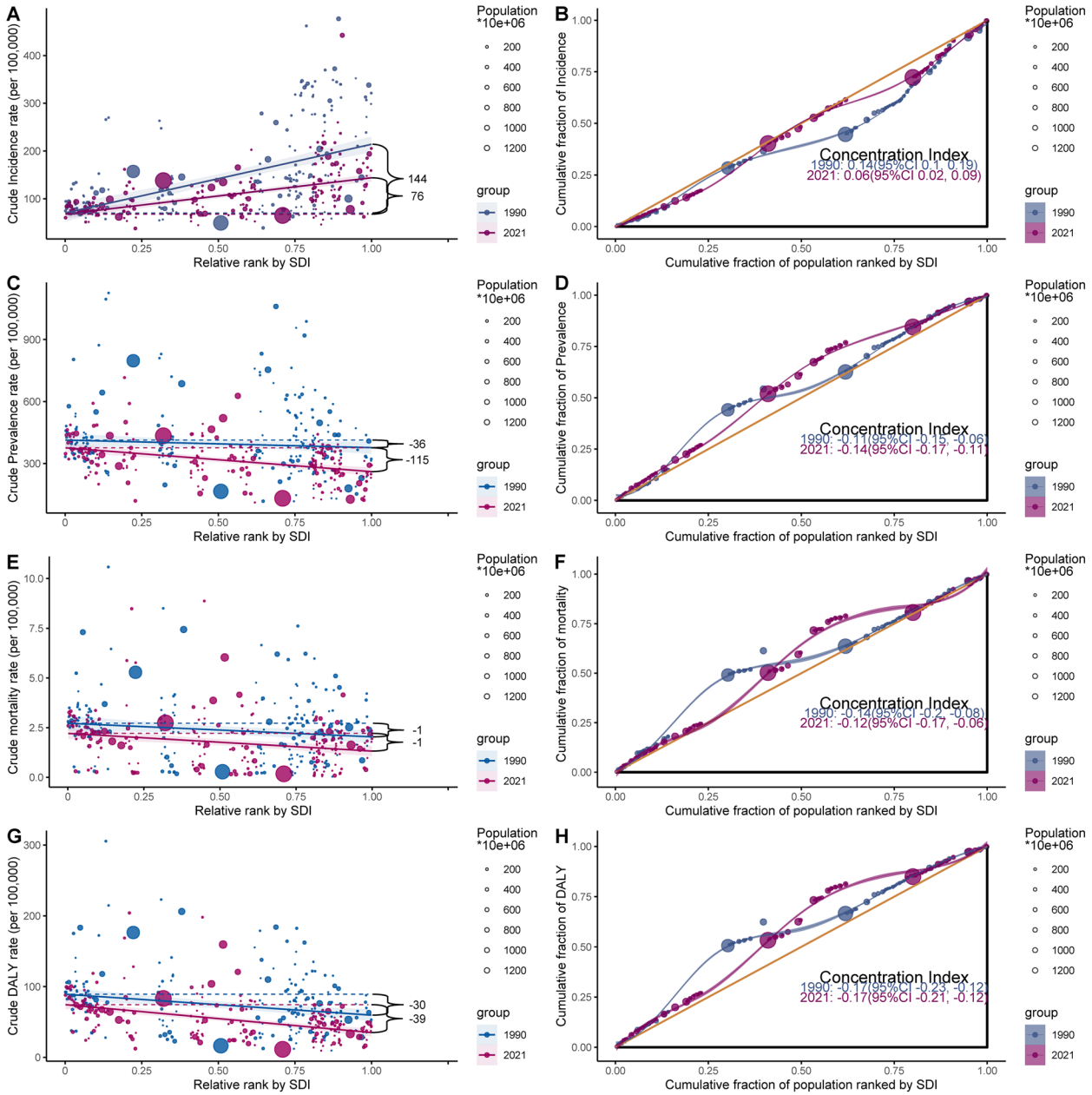

Fig. 10 Health inequality analysis for inguinal, femoral, and abdominal hernia burden, 1990–2021. Scatter plots illustrating the slope index of inequality (**A**, **C**, **E**, **G**) and concentration index (**B**, **D**, **F**, **H**) for incidence, prevalence, mortality, and DALYs across 204 countries from 1990 to 2021

hernia (Guatemala: 240.30 DALYs per 100,000, Paraguay: 232.06, Indonesia: 219.53) had notably low pharmaceutical personnel density (Guatemala: 1.15, Paraguay: 4.84, Indonesia: 5.83 per 10,000 population). Conversely, countries with the lowest burden (Democratic People's Republic of Korea: 12.59 DALYs, China: 11.70, Northern Mariana Islands: 10.18) generally maintained higher pharmaceutical personnel density (4.10, 7.57, and 12.43 per 10,000, respectively). Similar patterns were observed with dentistry personnel, where high-burden countries (Guatemala, Paraguay, Indonesia) had variable but generally inadequate dentistry workforce density (7.06, 6.93, and 2.47 per 10,000, respectively) compared to low-burden countries. Notably, the relationship appears to have strengthened between 1990 and 2019, with correlation coefficients for both workforce categories showing greater magnitude in 2019. This suggests that strategic

Table 13 Health inequality indices for incidence, prevalence, mortality, and DALYs of Inguinal, Femoral, and Abdominal Hernia in population aged 45 years and above, 1990 and 2021

Measure	Year	Health inequality index	value	95% CI
Incidence	1990	Slope index	143.722	177.296 to 143.722
	2021		76.302	91.546 to 76.302
	1990	Concentration index	0.144	0.097 to 0.191
	2021		0.058	0.023 to 0.093
Prevalence	1990	Slope index	− 36.479	23.305 to − 36.479
	2021		− 115.314	− 78.801 to − 115.314
	1990	Concentration index	− 0.107	− 0.151 to − 0.064
	2021		− 0.14	− 0.168 to − 0.112
Mortality	1990	Slope index	− 0.682	− 0.029 to − 0.682
	2021		− 0.89	− 0.45 to − 0.89
	1990	Concentration index	− 0.139	− 0.2 to − 0.077
	2021		− 0.117	− 0.175 to − 0.059
Mortality	1990	Slope index	− 29.551	− 13.896 to − 29.551
	2021		− 39.418	− 29.904 to − 39.418
	1990	Concentration index	− 0.174	− 0.227 to − 0.12
	2021		− 0.167	− 0.212 to − 0.121

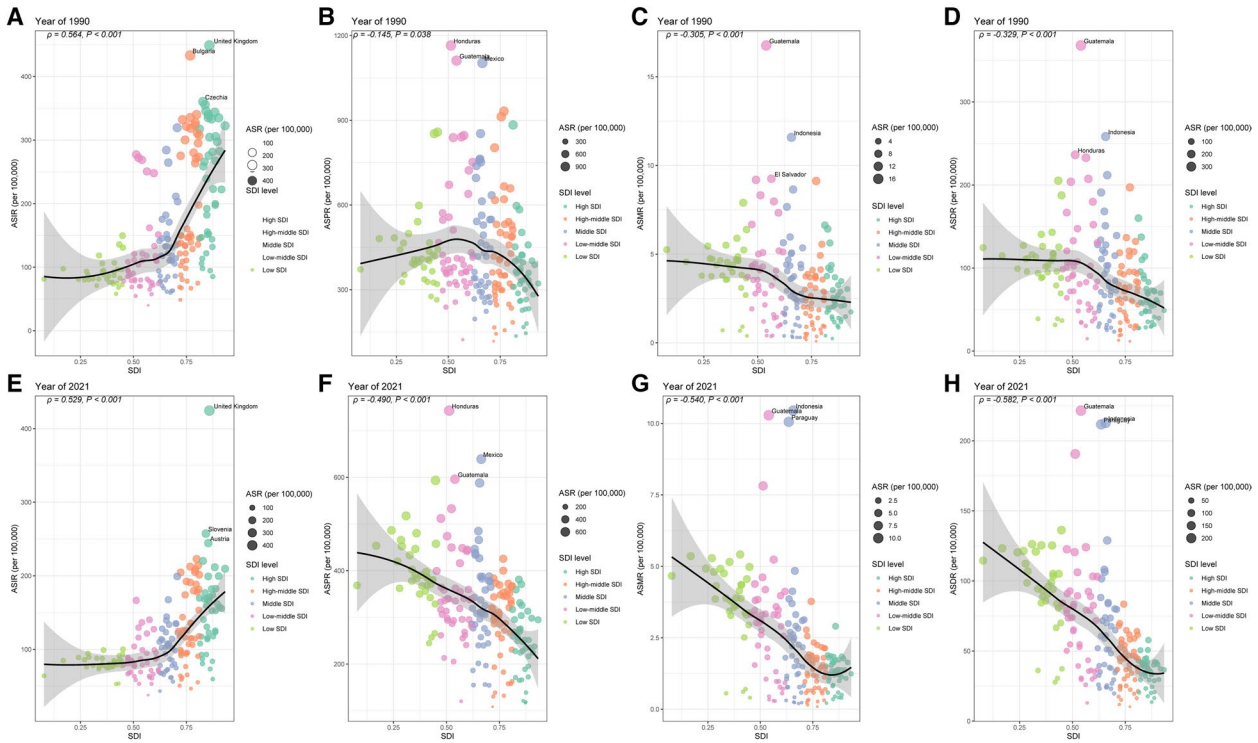

Fig. 11 Correlation between SDI and age-standardized rates of inguinal, femoral, and abdominal hernia by SDI regions, 1990 and 2021. Scatter plots showing the correlation between Socio-demographic Index (SDI) and age-standardized (**A**, **E**) incidence, **B**, **F** prevalence, **C**, **G** mortality, and **D**, **H** DALY rates across five SDI regions in 1990 and 2021

investment in pharmaceutical and dentistry personnel may contribute substantially to reducing hernia burden, particularly in resource-constrained settings where these workforce categories remain underdeveloped despite their apparent protective association with hernia-related health outcomes.

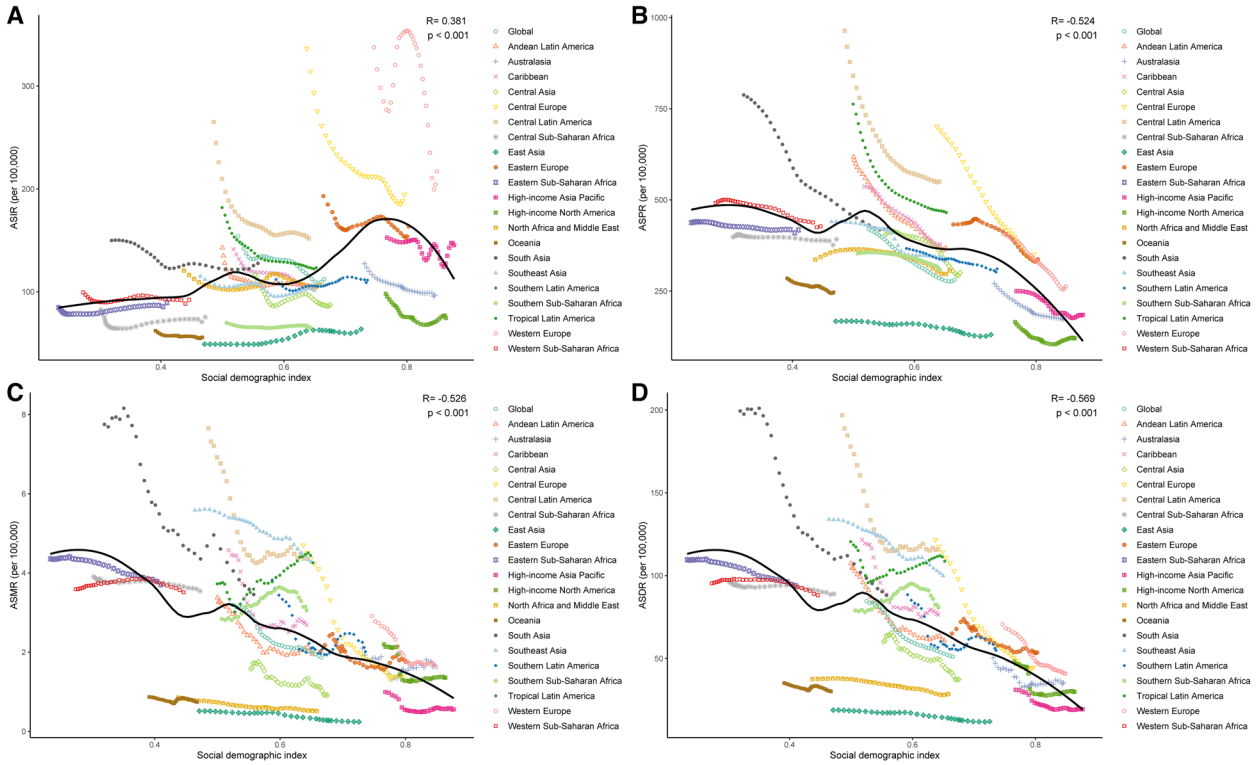

Fig. 12 Correlation between SDI and age-standardized rates of inguinal, femoral, and abdominal hernia by GBD regions, 1990–2021. Scatter plots depicting the correlation between SDI and age-standardized (**A**) incidence, **B** prevalence, **C** mortality, and **D** DALY rates across 21 GBD regions from 1990 to 2021

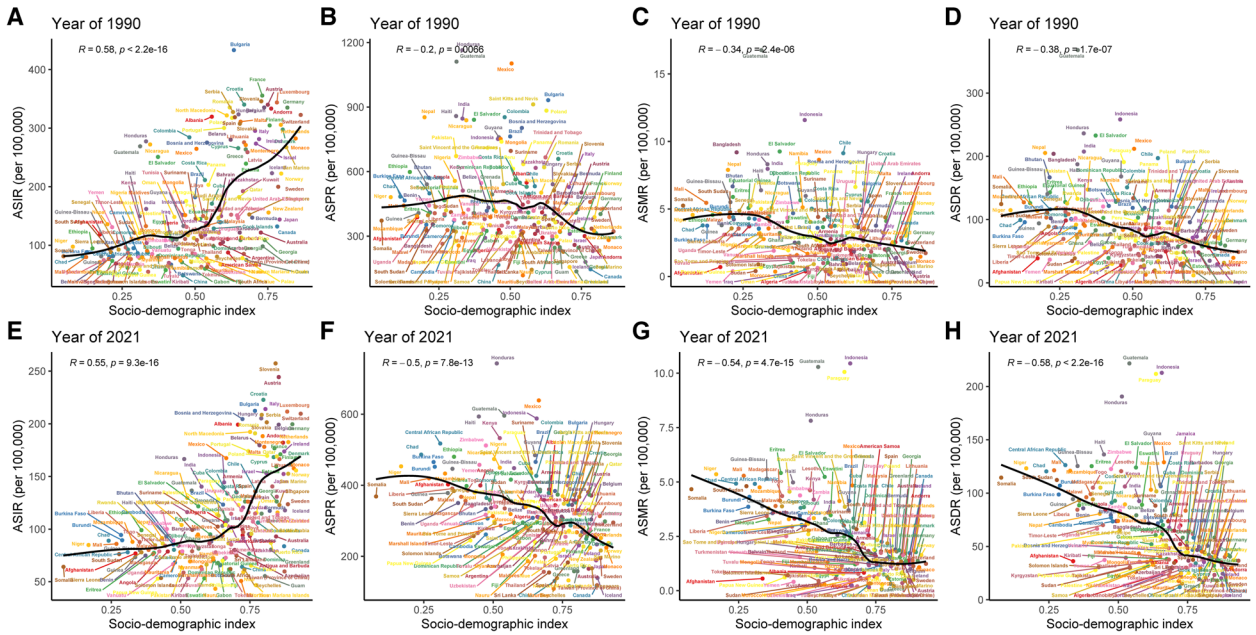

Fig. 13 Correlation between SDI and age-standardized rates of inguinal, femoral, and abdominal hernia by countries, 1990 and 2021. Scatter plots illustrating the correlation between SDI and age-standardized (**A**, **E**) incidence, **B**, **F** prevalence, **C**, **G** mortality, and **D**, **H** DALY rates across 204 countries in 1990 and 2021

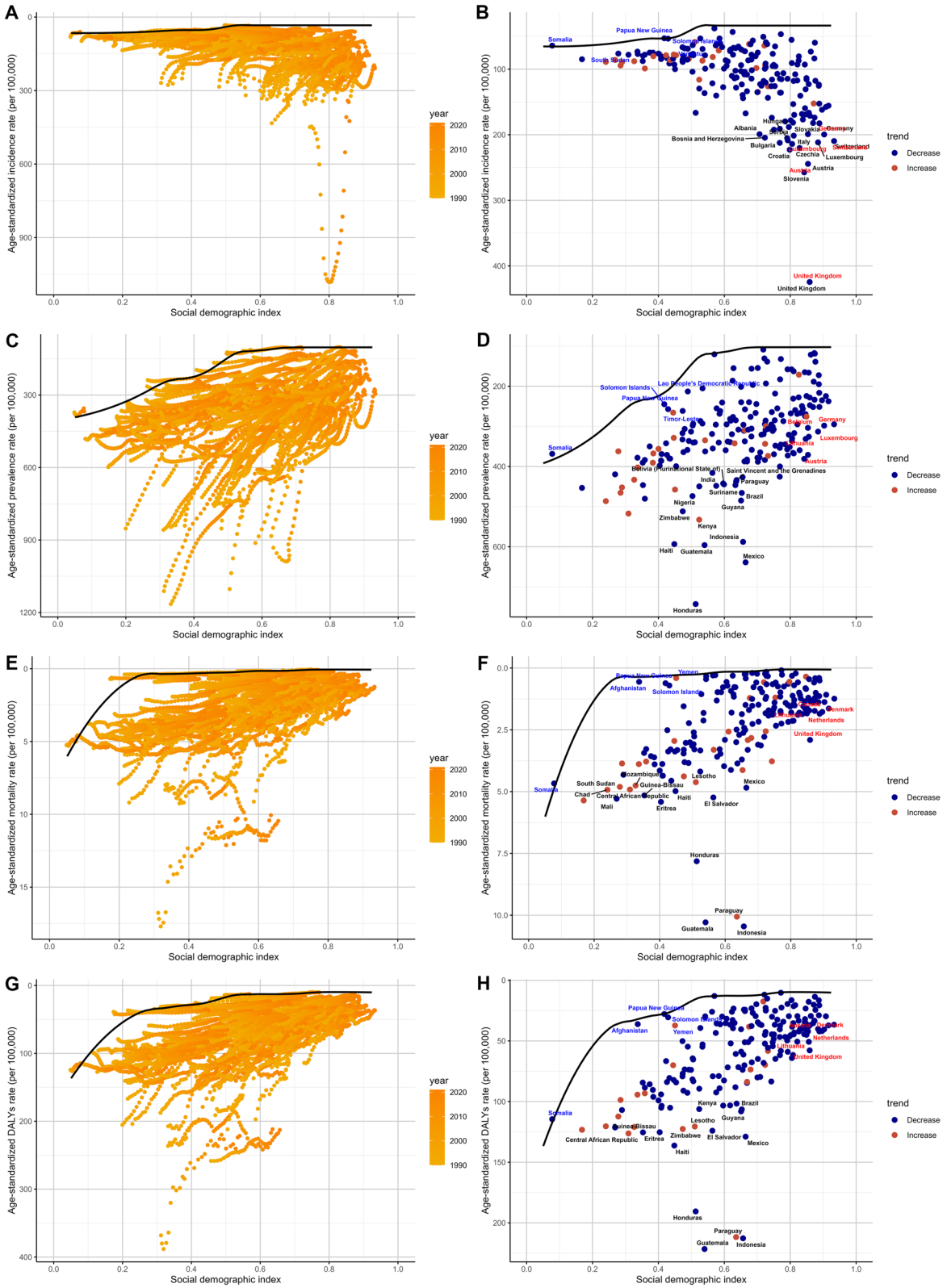

Fig. 14 Frontier analysis of inguinal, femoral, and abdominal hernia burden, 1990–2021 and 2021. Scatter plots showing the results of frontier analysis for age-standardized (**A**, **B** incidence, **C**, **D** prevalence, **E**, **F** mortality, and **G**, **H** DALY rates across 204 countries. Panels **A**, **C**, **E**, and **G** show trends from 1990 to 2021, while panels **B**, **D**, **F**, and **H** focus on the year 2021

Table 14 Frontier analysis of incidence for Inguinal, Femoral, and Abdominal Hernia in 204 countries and territories for population aged 45 years and above, 2021

Location	Incidence				
	SDI	Age-standardized rate	Frontier incidence	Effective difference	Effective difference rank (Age-standardized incidence rank)
Afghanistan	0.3372	76.893 (44.551 to 124.09)	53.975	22.919	21 (48)
Albania	0.70684979	199.21 (117.728 to 311.969)	33.518	165.692	190 (190)
Algeria	0.65950092	106.171 (60.48 to 172.688)	33.566	72.604	117 (116)
American Samoa	0.72372753	94.155 (62.049 to 135.844)	33.521	60.634	101 (98)
Andorra	0.86944411	182.071 (109.864 to 283.103)	33.656	148.415	184 (184)
Angola	0.45372195	78.759 (49.442 to 117.535)	52.068	26.692	33 (56)
Antigua and Barbuda	0.74988689	93.532 (57.336 to 141.499)	33.804	59.728	99 (96)
Argentina	0.72312297	99.426 (62.604 to 147.686)	33.563	65.863	110 (109)
Armenia	0.70183319	134.824 (87.329 to 195.571)	33.597	101.227	154 (154)
Australia	0.84425281	93.028 (57.666 to 143.682)	33.67	59.358	98 (94)
Austria	0.853837	244.412 (151.072 to 372.931)	33.542	210.87	202 (202)
Azerbaijan	0.69485127	80.266 (48.575 to 123.687)	33.569	46.697	84 (62)
Bahamas	0.80502067	90.753 (57.633 to 134.448)	33.698	57.055	95 (90)
Bahrain	0.7530432	125.863 (74.538 to 201.041)	33.7	92.162	146 (146)
Bangladesh	0.49242088	84.259 (47.9 to 138.33)	48.466	35.793	61 (71)
Barbados	0.74674876	95.279 (59.981 to 144.103)	33.71	61.569	105 (102)
Belarus	0.78448471	179.625 (110.84 to 274.623)	33.679	145.946	182 (182)
Belgium	0.85365402	199.154 (118.574 to 311.159)	33.536	165.619	189 (189)
Belize	0.610229	88.214 (55.44 to 132.257)	33.59	54.625	94 (86)
Benin	0.37348657	74.83 (47.053 to 112.271)	53.608	21.222	16 (42)
Bermuda	0.82136542	117.297 (73.149 to 181.121)	33.645	83.652	134 (134)
Bhutan	0.47306238	88.135 (54.609 to 133.491)	48.911	39.224	71 (85)
Bolivia (Plurinational State of)	0.5990108	99.194 (62.132 to 149.623)	33.58	65.614	108 (107)
Bosnia and Herzegovina	0.72307789	204.522 (126.357 to 310.918)	33.716	170.806	193 (193)
Botswana	0.64272163	65.662 (42.104 to 98.33)	33.578	32.083	50 (24)
Brazil	0.65304389	123.269 (77.245 to 184.446)	33.567	89.702	142 (142)

Table 14 (continued)

Location	Incidence				
	SDI	Age-standardized rate	Frontier incidence	Effective difference	Effective difference rank (Age-standardized incidence rank)
Brunei Darussalam	0.81023437	118.073 (68.119 to 189.513)	33.683	84.391	136 (137)
Bulgaria	0.76815094	212.345 (131.891 to 319.933)	33.663	178.682	198 (198)
Burkina Faso	0.2851184	94.471 (59.356 to 140.881)	60.285	34.186	57 (99)
Burundi	0.28937436	89.459 (54.947 to 135.997)	59.737	29.722	43 (89)
Cabo Verde	0.53353454	87.109 (55.539 to 130.552)	33.585	53.525	93 (82)
Cambodia	0.47362149	85.298 (55.489 to 124.72)	49.618	35.68	60 (74)
Cameroon	0.47969122	68.308 (43.168 to 102.864)	49.719	18.589	11 (29)
Canada	0.87317068	83.745 (53.578 to 125.705)	33.57	50.176	88 (69)
Central African Republic	0.30916769	78.057 (48.106 to 116.907)	60.338	17.719	10 (54)
Chad	0.24043602	89.014 (55.624 to 132.694)	64.048	24.967	27 (87)
Chile	0.77151472	135.901 (90.019 to 196.885)	33.594	102.307	157 (156)
China	0.72162976	64.157 (37.517 to 102.55)	33.92	30.238	45 (21)
Colombia	0.65544291	139.471 (90.014 to 203.778)	33.556	105.915	159 (159)
Comoros	0.47597869	80.374 (50.639 to 121.381)	51.161	29.213	42 (63)
Congo	0.58307524	71.575 (45.979 to 105.938)	33.53	38.045	66 (35)
Cook Islands	0.77910995	106.188 (70.144 to 152.953)	33.517	72.671	118 (117)
Costa Rica	0.70034048	135.195 (85.668 to 202.142)	33.62	101.576	155 (155)
Coted'Ivoire	0.42594188	83.166 (52.934 to 123.463)	52.2	30.965	47 (68)
Croatia	0.79834103	222.824 (147.358 to 318.563)	33.568	189.256	201 (201)
Cuba	0.66872986	133.736 (86.407 to 199.435)	33.597	100.139	153 (153)
Cyprus	0.83563055	168.394 (100.559 to 264.336)	33.568	134.827	174 (174)
Czechia	0.82845043	220.136 (134.88 to 337.37)	33.599	186.538	200 (200)
Democratic People's Republic of Korea	0.56985463	38.002 (22.616 to 60.179)	33.698	4.304	4 (1)
Democratic Republic of the Congo	0.38317985	74.845 (47.882 to 110.858)	53.041	21.805	19 (43)
Denmark	0.8964242	161.915 (99.321 to 249.001)	33.566	128.349	170 (170)
Djibouti	0.48795837	85.506 (53.255 to 128.127)	48.503	37.003	64 (76)

Table 14 (continued)

Location	Incidence				
	SDI	Age-standardized rate	Frontier incidence	Effective difference	Effective difference rank (Age-standardized incidence rank)
Dominica	0.74696718	76.642 (47.285 to 117.435)	33.661	42.981	76 (46)
Dominican Republic	0.6193882	69.933 (41.077 to 111.118)	33.635	36.298	62 (32)
Ecuador	0.66101705	108.101 (70.685 to 159.009)	33.591	74.51	121 (121)
Egypt	0.60678709	94.999 (55.128 to 152.939)	33.74	61.259	103 (101)
El Salvador	0.56377519	121.636 (78.125 to 179.676)	33.521	88.115	139 (139)
Equatorial Guinea	0.65785746	71.763 (44.794 to 107.481)	33.717	38.046	67 (36)
Eritrea	0.40386394	77.499 (47.433 to 117.129)	53.002	24.497	25 (49)
Estonia	0.84491779	159.553 (94.798 to 252.568)	33.571	125.983	169 (169)
Eswatini	0.58545971	53.228 (33.962 to 79.232)	33.559	19.668	13 (6)
Ethiopia	0.3588233	99.02 (59.214 to 151.603)	54.019	45.001	81 (106)
Fiji	0.67505163	61.755 (39.942 to 91.45)	33.598	28.157	36 (15)
Finland	0.85983137	171.132 (106.256 to 263.283)	33.73	137.402	177 (177)
France	0.83836488	176.787 (106.643 to 279.107)	33.538	143.249	180 (180)
Gabon	0.63469139	67.926 (43.178 to 99.705)	33.56	34.366	58 (28)
Gambia	0.40971416	80.985 (51.837 to 119.219)	52.279	28.706	40 (65)
Georgia	0.7324736	126.179 (83.474 to 180.008)	33.623	92.556	148 (148)
Germany	0.90295709	199.591 (119.128 to 318.302)	33.727	165.864	191 (191)
Ghana	0.56493039	81.462 (52.564 to 119.75)	33.542	47.92	87 (66)
Greece	0.79185441	114.642 (72.122 to 171.09)	33.523	81.119	129 (128)
Greenland	0.82621034	80.565 (52.192 to 117.242)	33.541	47.024	85 (64)
Grenada	0.66899303	108.361 (69.76 to 160.064)	33.515	74.846	122 (122)
Guam	0.8039822	55.358 (34.72 to 83.785)	33.569	21.789	18 (9)
Guatemala	0.53997242	136.607 (89.418 to 199.404)	33.717	102.89	158 (158)
Guinea	0.33640129	73.343 (46.269 to 108.738)	53.981	19.362	12 (39)
Guinea-Bissau	0.35310962	79.823 (49.585 to 119.261)	54.285	25.539	30 (60)
Guyana	0.65081234	103.138 (66.107 to 153.998)	33.538	69.601	113 (113)
Haiti	0.44827828	93.088 (56.256 to 142.377)	52.409	40.679	74 (95)

Table 14 (continued)

Location	Incidence				
	SDI	Age-standardized rate	Frontier incidence	Effective difference	Effective difference rank (Age-standardized incidence rank)
Honduras	0.51303725	166.576 (106.319 to 244.243)	33.586	132.991	172 (172)
Hungary	0.79075477	205.167 (129.029 to 307.174)	33.555	171.611	194 (194)
Iceland	0.87636168	117.775 (66.908 to 200.723)	33.589	84.186	135 (135)
India	0.57540165	140.324 (83.445 to 219.389)	33.573	106.752	160 (160)
Indonesia	0.65686834	144.364 (93.147 to 209.197)	33.561	110.803	163 (163)
Iran (Islamic Republic of)	0.6972074	98.38 (55.901 to 159.709)	33.566	64.813	107 (105)
Iraq	0.66262623	106.233 (60.907 to 174.59)	33.632	72.602	116 (118)
Ireland	0.87375385	173.831 (105.048 to 269.656)	33.561	140.27	178 (178)
Israel	0.80901165	153.245 (91.237 to 242.197)	33.715	119.529	166 (166)
Italy	0.80577353	214.051 (129.468 to 331.836)	33.605	180.446	199 (199)
Jamaica	0.68326306	101.735 (64.599 to 152.44)	33.572	68.163	111 (111)
Japan	0.87124181	152.373 (89.346 to 245.307)	33.543	118.831	165 (164)
Jordan	0.72530723	120.45 (70.318 to 188.491)	33.558	86.892	138 (138)
Kazakhstan	0.7251445	91.558 (56.452 to 139.964)	33.544	58.014	96 (92)
Kenya	0.52376808	116.1 (70.796 to 175.768)	33.782	82.318	132 (133)
Kiribati	0.52718658	53.271 (32.858 to 79.769)	33.571	19.7	14 (7)
Kuwait	0.84665105	130.735 (76.818 to 206.754)	33.542	97.192	152 (152)
Kyrgyzstan	0.60397933	86.543 (50.298 to 138.496)	33.57	52.973	90 (79)
Lao People's Democratic Republic	0.48913609	68.878 (43.527 to 102.213)	48.6	20.278	15 (30)
Latvia	0.83066352	140.524 (82.459 to 221.572)	33.702	106.822	161 (161)
Lebanon	0.74474635	115.943 (66.018 to 189.844)	33.567	82.376	133 (132)
Lesotho	0.51039307	58.656 (37.523 to 86.527)	33.768	24.888	26 (11)
Liberia	0.35244245	87.744 (54.682 to 131.913)	54.01	33.734	53 (83)
Libya	0.7257714	97.165 (55.362 to 156.483)	33.573	63.592	106 (104)
Lithuania	0.85648405	166.492 (101.73 to 251.301)	33.549	132.943	171 (171)
Luxembourg	0.88442896	211.619 (125.841 to 330.871)	33.668	177.951	197 (197)

Table 14 (continued)

Location	Incidence				
	SDI	Age-standardized rate	Frontier incidence	Effective difference	Effective difference rank (Age-standardized incidence rank)
Madagascar	0.40024694	76.252 (47.081 to 115.822)	53.069	23.183	22 (44)
Malawi	0.38455363	80.264 (50.42 to 119.465)	53.039	27.225	34 (61)
Malaysia	0.74252383	126.028 (84.052 to 178.679)	33.666	92.362	147 (147)
Maldives	0.65088663	93.94 (59.869 to 138.579)	33.698	60.242	100 (97)
Mali	0.26857994	85.988 (53.64 to 127.527)	62.242	23.746	23 (77)
Malta	0.80158503	178.089 (107.552 to 277.971)	34.012	144.077	181 (181)
Marshall Islands	0.57409113	63.896 (40.68 to 95.598)	33.53	30.366	46 (20)
Mauritania	0.4989451	78.085 (49.108 to 115.984)	33.872	44.213	78 (55)
Mauritius	0.71826045	50.729 (30.179 to 80.282)	33.575	17.154	9 (4)
Mexico	0.6645753	167.432 (105.994 to 249.352)	33.576	133.857	173 (173)
Micronesia (Federated States of)	0.58753497	60.86 (38.62 to 90.806)	33.586	27.275	35 (14)
Monaco	0.90826283	157.694 (92.625 to 252.784)	33.573	124.121	168 (168)
Mongolia	0.61762156	70.984 (41.264 to 113.604)	33.659	37.325	65 (34)
Montenegro	0.79580058	188.252 (110.05 to 298.759)	33.619	154.634	186 (186)
Morocco	0.5626983	94.842 (55.218 to 152.032)	33.64	61.202	102 (100)
Mozambique	0.32646261	87.945 (54.908 to 130.198)	53.918	34.028	56 (84)
Myanmar	0.53390084	69.325 (44.7 to 100.991)	33.825	35.499	59 (31)
Namibia	0.61756487	72.483 (45.847 to 109.731)	33.834	38.649	68 (37)
Nauru	0.62517783	43.31 (26.831 to 65.912)	33.659	9.651	5 (2)
Nepal	0.43317463	91.427 (57.903 to 135.427)	52.361	39.066	70 (91)
Netherlands	0.88846426	182.585 (111.294 to 281.594)	33.655	148.931	185 (185)
New Zealand	0.8494425	115.745 (70.18 to 179.153)	33.629	82.116	131 (131)
Nicaragua	0.52395847	129.634 (84.108 to 190.934)	33.57	96.063	151 (151)
Niger	0.16807277	84.94 (52.335 to 126.421)	63.561	21.379	17 (73)
Nigeria	0.50339083	103.978 (61.965 to 160.352)	33.7	70.278	114 (114)
Niue	0.72622205	59.106 (37.549 to 87.92)	33.574	25.531	29 (12)
North Macedonia	0.7506297	192.317 (118.518 to 296.41)	33.669	158.648	188 (188)

Table 14 (continued)

Location	Incidence				
	SDI	Age-standardized rate	Frontier incidence	Effective difference	Effective difference rank (Age-standardized incidence rank)
Northern Mariana Islands	0.77153521	46.723 (27.862 to 74.229)	33.582	13.141	6 (3)
Norway	0.91613281	155.724 (92.31 to 247.08)	33.625	122.1	167 (167)
Oman	0.7733916	115.362 (65.6 to 188.721)	33.59	81.772	130 (130)
Pakistan	0.50402869	63.456 (37.419 to 100.03)	33.566	29.89	44 (19)
Palau	0.75404693	65.349 (41.639 to 97.286)	33.6	31.749	49 (23)
Palestine	0.63101167	114.049 (64.821 to 183.738)	33.684	80.366	126 (126)
Panama	0.70886483	122.886 (74.999 to 188.622)	33.656	89.229	140 (141)
Papua New Guinea	0.41779744	52.97 (31.969 to 81.915)	52.095	0.875	2 (5)
Paraguay	0.6357181	128.177 (81.396 to 188.466)	33.835	94.342	150 (150)
Peru	0.66205404	104.112 (63.992 to 159.62)	33.608	70.503	115 (115)
Philippines	0.65121933	70.016 (43.631 to 105.197)	33.547	36.469	63 (33)
Poland	0.81204281	169.7 (101.344 to 267.378)	33.718	135.982	176 (176)
Portugal	0.74415185	174.081 (109.594 to 256.642)	33.559	140.522	179 (179)
Puerto Rico	0.82552585	87.03 (52.963 to 136.751)	33.516	53.514	92 (81)
Qatar	0.84686058	169.083 (99.523 to 267.94)	33.575	135.508	175 (175)
Republic of Korea	0.88667527	125.423 (72.996 to 199.427)	33.576	91.846	145 (145)
Republic of Moldova	0.73221488	143.734 (88.874 to 218.463)	33.587	110.147	162 (162)
Romania	0.76845386	190.946 (117.208 to 294.12)	33.674	157.272	187 (187)
Russian Federation	0.808536	181.553 (109.016 to 283.239)	33.568	147.985	183 (183)
Rwanda	0.43558871	86.241 (53.326 to 128.683)	52.225	34.016	55 (78)
Saint Kitts and Nevis	0.75498705	95.517 (60.841 to 141.16)	34.038	61.479	104 (103)
Saint Lucia	0.67250974	86.595 (53.728 to 132.557)	33.564	53.03	91 (80)
Saint Vincent and the Grenadines	0.63719596	112.707 (73.611 to 163.525)	33.58	79.127	124 (124)
Samoa	0.59339277	66.307 (42.327 to 99.32)	33.572	32.734	52 (25)
San Marino	0.88800547	152.593 (88.345 to 244.161)	33.766	118.828	164 (165)
Sao Tome and Principe	0.50541375	76.727 (48.029 to 115.037)	33.656	43.071	77 (47)

Table 14 (continued)

Location	Incidence				
	SDI	Age-standardized rate	Frontier incidence	Effective difference	Effective difference rank (Age-standardized incidence rank)
Saudi Arabia	0.81514349	107.891 (61.867 to 175.065)	33.66	74.231	120 (120)
Senegal	0.40805419	84.618 (53.452 to 126.368)	52.982	31.635	48 (72)
Serbia	0.79241629	208.507 (132.749 to 311.451)	33.577	174.93	195 (195)
Seychelles	0.73015077	61.848 (38.998 to 91.918)	33.677	28.172	37 (16)
Sierra Leone	0.35866588	78.004 (49.692 to 116.029)	54.013	23.99	24 (53)
Singapore	0.85609777	122.881 (72.888 to 191.629)	33.65	89.231	141 (140)
Slovakia	0.81061053	201.422 (123.541 to 307.66)	33.595	167.827	192 (192)
Slovenia	0.84243073	257.35 (159.475 to 393.848)	33.678	223.672	203 (203)
Solomon Islands	0.42936032	53.549 (33.002 to 80.733)	51.854	1.695	3 (8)
Somalia	0.07768811	64.167 (39.526 to 96.628)	63.47	0.697	1 (22)
South Africa	0.6796266	62.058 (38.513 to 93.234)	33.563	28.495	39 (18)
South Sudan	0.27837113	76.272 (47.076 to 115.974)	61.616	14.656	7 (45)
Spain	0.7692837	135.971 (87.681 to 200.385)	33.667	102.304	156 (157)
Sri Lanka	0.70153494	74.777 (47.48 to 112.443)	33.763	41.014	75 (41)
Sudan	0.54194974	99.289 (57.318 to 159.409)	33.655	65.634	109 (108)
Suriname	0.63366574	102.429 (65.551 to 153.927)	33.757	68.672	112 (112)
Sweden	0.8868803	123.609 (73.121 to 195.407)	33.561	90.048	143 (143)
Switzerland	0.93305911	209.604 (123.576 to 335.006)	33.689	175.916	196 (196)
Syrian Arab Republic	0.62300407	110.261 (63.261 to 179.029)	33.568	76.693	123 (123)
Taiwan (Province of China)	0.87474705	59.75 (36.467 to 92.277)	33.536	26.214	31 (13)
Tajikistan	0.54151119	78.991 (44.476 to 129.889)	33.594	45.398	83 (59)
Thailand	0.68254793	77.941 (50.331 to 113.339)	33.582	44.359	79 (51)
Timor-Leste	0.44466762	84.11 (52.096 to 127.026)	51.96	32.15	51 (70)
Togo	0.4085337	82.123 (51.753 to 122.767)	52.957	29.165	41 (67)
Tokelau	0.68642562	56.375 (35.226 to 85.014)	33.722	22.653	20 (10)
Tonga	0.62634994	77.945 (50.73 to 113.383)	33.567	44.378	80 (52)
Trinidad and Tobago	0.76876325	114.743 (74.481 to 168.263)	33.787	80.955	128 (129)

Table 14 (continued)

Location	Incidence				
	SDI	Age-standardized rate	Frontier incidence	Effective difference	Effective difference rank (Age-standardized incidence rank)
Tunisia	0.68243222	114.473 (65.311 to 183.28)	33.673	80.8	127 (127)
Turkey	0.71269267	125.254 (74.381 to 197.562)	33.565	91.689	144 (144)
Turkmenistan	0.68216078	85.393 (53.3 to 129.816)	33.661	51.732	89 (75)
Tuvalu	0.57662053	61.963 (39.238 to 92.628)	33.539	28.424	38 (17)
Uganda	0.42326118	78.917 (50.105 to 118.623)	52.58	26.336	32 (58)
Ukraine	0.76077391	107.182 (61.13 to 174.328)	33.587	73.595	119 (119)
United Arab Emirates	0.84931773	113.635 (65.266 to 184.393)	33.588	80.047	125 (125)
United Kingdom	0.85900018	424.491 (252.471 to 661.808)	33.749	390.742	204 (204)
United Republic of Tanzania	0.44656827	77.744 (49.145 to 116.38)	52.228	25.516	28 (50)
United States Virgin Islands	0.82183085	92.921 (58.789 to 140.192)	33.766	59.155	97 (93)
United States of America	0.86244835	73.35 (43.932 to 114.564)	33.704	39.646	73 (40)
Uruguay	0.71928344	118.065 (75.162 to 175.132)	33.537	84.528	137 (136)
Uzbekistan	0.66262169	72.781 (43.146 to 113.663)	33.722	39.059	69 (38)
Vanuatu	0.47310071	66.685 (42.099 to 99.92)	51.416	15.269	8 (26)
Venezuela (Bolivarian Republic of)	0.59651306	127.473 (81.053 to 190.825)	33.648	93.825	149 (149)
Viet Nam	0.62793372	67.523 (42.171 to 100.915)	33.64	33.883	54 (27)
Yemen	0.45037638	100.018 (58.334 to 160.316)	52.203	47.815	86 (110)
Zambia	0.50594895	78.898 (50.867 to 117.846)	33.615	45.284	82 (57)
Zimbabwe	0.47381949	89.046 (56.242 to 131.748)	49.411	39.635	72 (88)

Projected burden of inguinal, femoral and abdominal hernia: 2022–2050

In this study, eight different time series machine learning models were used to predict the disease burden of inguinal, femoral and abdominal wall hernias, including Prophet, ARIMA, TBATS, ElasticNet, ETS, VAR, HoltWinters and Theta models. This multi-model approach aims to comprehensively assess the performance of different prediction techniques and select the model that best fits the characteristics of the data, thus ensuring the accuracy and reliability of the predictions. By comparing the performance of these models on metrics such as mean square error (MSE), mean absolute percentage error (MAPE), root mean square error (RMSE), and coefficient of determination (R2), we found that the ARIMA model performs the best in the prediction of both age-standardized rates and absolute quantities (Figs. 15, 16, Tables 18 and 19).

In age-standardized rate prediction, the ARIMA model showed the highest accuracy on all four metrics. Specifically, in incidence prediction, the ARIMA model had an MSE of 0.122, a MAPE of 0.220%, an RMSE of 0.349,

Table 15 Frontier analysis of prevalence for Inguinal, Femoral, and Abdominal Hernia in 204 countries and territories for population aged 45 years and above, 2021

Location	Prevalence				
	SDI	Age-standardized rate	Frontier prevalence	Effective difference	Effective difference rank (Age-standardized prevalence rank)
Afghanistan	0.3372	402.418 (262.154 to 586.519)	239.014	163.404	79 (174)
Albania	0.70684979	377.618 (236.872 to 576.314)	102.96	274.658	175 (155)
Algeria	0.65950092	311.012 (189.729 to 476.844)	105.235	205.777	129 (99)
American Samoa	0.72372753	343.651 (255.072 to 453.731)	102.669	240.982	156 (127)
Andorra	0.86944411	251.914 (160.331 to 380.914)	102.708	149.206	65 (47)
Angola	0.45372195	399.503 (294.087 to 529.983)	198.159	201.344	122 (172)
Antigua and Barbuda	0.74988689	307.505 (207.832 to 436.849)	102.794	204.711	126 (94)
Argentina	0.72312297	294.561 (205.55 to 411.347)	102.686	191.874	110 (78)
Armenia	0.70183319	388.149 (278.386 to 525.478)	103.036	285.112	183 (168)
Australia	0.84425281	165.064 (107.843 to 245.531)	102.688	62.376	20 (16)
Austria	0.853837	371.059 (243.371 to 549.842)	102.621	268.437	172 (151)
Azerbaijan	0.69485127	266.66 (173.394 to 387.227)	102.917	163.743	80 (59)
Bahamas	0.80502067	336.25 (238.375 to 461.355)	102.907	233.343	152 (117)
Bahrain	0.7530432	284.919 (173.927 to 443.61)	102.834	182.085	104 (71)
Bangladesh	0.49242088	336.464 (206.741 to 513.581)	168.327	168.137	88 (118)
Barbados	0.74674876	311.443 (215.845 to 436.019)	102.423	209.02	132 (100)
Belarus	0.78448471	344.835 (229.389 to 502.741)	102.786	242.049	157 (128)
Belgium	0.85365402	303.688 (190.227 to 467.506)	102.55	201.137	121 (90)
Belize	0.610229	337.876 (240.764 to 462.967)	113.394	224.482	146 (120)
Benin	0.37348657	350.031 (260.053 to 461.758)	234.887	115.144	36 (131)
Bermuda	0.82136542	268.968 (178.544 to 391.586)	102.839	166.129	83 (62)
Bhutan	0.47306238	332.797 (230.155 to 466.968)	166.608	166.189	84 (115)
Bolivia (Plurinational State of)	0.5990108	444.656 (321.599 to 596.648)	113.737	330.919	193 (183)
Bosnia and Herzegovina	0.72307789	383.838 (253.219 to 563.552)	102.882	280.956	180 (163)
Botswana	0.64272163	308.071 (228.825 to 406.868)	106.438	201.633	123 (95)
Brazil	0.65304389	465.909 (345.148 to 617.931)	106.387	359.522	197 (192)

Table 15 (continued)

Location	Prevalence				
	SDI	Age-standardized rate	Frontier prevalence	Effective difference	Effective difference rank (Age-standardized prevalence rank)
Brunei Darussalam	0.81023437	162.713 (98.064 to 255.796)	102.925	59.788	19 (15)
Bulgaria	0.76815094	425.474 (286.995 to 610.546)	102.935	322.539	187 (177)
Burkina Faso	0.2851184	465.498 (343.478 to 616.936)	240.325	225.172	147 (191)
Burundi	0.28937436	452.23 (327.42 to 609.827)	240.358	211.872	136 (188)
Cabo Verde	0.53353454	292.982 (208.514 to 399.77)	126.077	166.905	85 (76)
Cambodia	0.47362149	261.609 (192.143 to 346.249)	187.126	74.483	25 (54)
Cameroon	0.47969122	306.396 (224.307 to 411.625)	168.814	137.582	54 (92)
Canada	0.87317068	117.334 (78.803 to 170.897)	102.639	14.694	4 (2)
Central African Republic	0.30916769	517.388 (389.252 to 676.865)	239.629	277.759	177 (198)
Chad	0.24043602	486.437 (358.538 to 644.874)	328.129	158.308	74 (196)
Chile	0.77151472	345.464 (253.145 to 461.592)	102.642	242.822	159 (129)
China	0.72162976	130.664 (78.949 to 200.747)	102.95	27.714	7 (6)
Colombia	0.65544291	426.701 (304.043 to 590.517)	104.894	321.807	186 (178)
Comoros	0.47597869	364.329 (261.018 to 498.46)	167.331	196.998	117 (143)
Congo	0.58307524	340.361 (252.817 to 451.348)	115.028	225.333	148 (124)
Cook Islands	0.77910995	287.08 (205.775 to 389.718)	102.842	184.238	106 (75)
Costa Rica	0.70034048	378.321 (262.644 to 533.296)	103.189	275.132	176 (157)
Coted'Ivoire	0.42594188	371.156 (276.725 to 486.622)	197.035	174.121	97 (152)
Croatia	0.79834103	351.362 (259.83 to 468.792)	102.555	248.806	162 (132)
Cuba	0.66872986	382.725 (271.262 to 528.204)	103.061	279.663	179 (161)
Cyprus	0.83563055	249.471 (155.381 to 387.355)	102.667	146.803	63 (45)
Czechia	0.82845043	359.471 (230.421 to 545.015)	102.558	256.913	166 (139)
Democratic People's Republic of Korea	0.56985463	120.362 (76.78 to 178.311)	117.809	2.553	1 (4)
Democratic Republic of the Congo	0.38317985	390.725 (292.636 to 513.993)	235.316	155.41	71 (170)
Denmark	0.8964242	235.054 (154.273 to 352.109)	102.686	132.369	48 (37)
Djibouti	0.48795837	358.738 (254.061 to 492.102)	168.149	190.589	109 (138)
Dominica	0.74696718	300.779 (206.665 to 422.104)	102.831	197.948	119 (89)

Table 15 (continued)

Location	Prevalence				
	SDI	Age-standardized rate	Frontier prevalence	Effective difference	Effective difference rank (Age-standardized prevalence rank)
Dominican Republic	0.6193882	285.962 (187.003 to 416.105)	117.881	168.081	87 (73)
Ecuador	0.66101705	387.46 (290.268 to 507.497)	103.696	283.764	182 (166)
Egypt	0.60678709	295.151 (182.288 to 452.091)	117.132	178.019	99 (81)
El Salvador	0.56377519	415.967 (301.383 to 569.458)	117.977	297.99	185 (175)
Equatorial Guinea	0.65785746	296.17 (212.444 to 403.012)	106.833	189.337	108 (84)
Eritrea	0.40386394	397.976 (284.343 to 538.688)	234.757	163.219	78 (171)
Estonia	0.84491779	274.458 (171.068 to 421.098)	102.659	171.799	93 (65)
Eswatini	0.58545971	268.609 (198.29 to 353.326)	115.374	153.234	68 (61)
Ethiopia	0.3588233	480.374 (333.549 to 661.662)	238.165	242.209	158 (194)
Fiji	0.67505163	239.84 (173.965 to 323.372)	103.032	136.809	53 (39)
Finland	0.85983137	247.363 (162.239 to 372.415)	102.641	144.722	60 (44)
France	0.83836488	256.468 (163.095 to 393.568)	102.672	153.796	69 (50)
Gabon	0.63469139	284.861 (208.364 to 381.951)	107.929	176.933	98 (70)
Gambia	0.40971416	369.015 (275.461 to 486.294)	229.281	139.734	56 (149)
Georgia	0.7324736	373.685 (279.477 to 489.436)	102.907	270.778	174 (154)
Germany	0.90295709	298.186 (184.764 to 465.784)	102.627	195.559	115 (86)
Ghana	0.56493039	355.142 (263.838 to 464.966)	116.883	238.259	155 (134)
Greece	0.79185441	157.919 (106.776 to 226.557)	102.905	55.014	16 (13)
Greenland	0.82621034	171.248 (120.514 to 239.525)	102.471	68.777	23 (18)
Grenada	0.66899303	387.591 (280.069 to 526.368)	105.411	282.18	181 (167)
Guam	0.8039822	157.99 (107.453 to 224.158)	102.687	55.303	17 (14)
Guatemala	0.53997242	596.059 (455.042 to 767.517)	123.946	472.113	201 (202)
Guinea	0.33640129	378.242 (281.728 to 498.358)	237.534	140.707	58 (156)
Guinea-Bissau	0.35310962	446.489 (330.259 to 588.881)	238.88	207.609	131 (184)
Guyana	0.65081234	484.891 (366.859 to 633.825)	105.277	379.615	198 (195)
Haiti	0.44827828	593.52 (432.693 to 794.589)	199.431	394.089	199 (201)
Honduras	0.51303725	743.002 (555.134 to 973.958)	125.459	617.542	204 (204)

Table 15 (continued)

Location	Prevalence				
	SDI	Age-standardized rate	Frontier prevalence	Effective difference	Effective difference rank (Age-standardized prevalence rank)
Hungary	0.79075477	357.182 (243.522 to 511.197)	102.924	254.258	164 (136)
Iceland	0.87636168	138.979 (82.918 to 219.463)	102.588	36.39	10 (9)
India	0.57540165	448.276 (305.824 to 620.865)	115.271	333.005	194 (186)
Indonesia	0.65686834	587.96 (441.252 to 766.461)	105.059	482.901	202 (200)
Iran (Islamic Republic of)	0.6972074	244.405 (142.169 to 383.48)	103.056	141.349	59 (42)
Iraq	0.66262623	309.933 (189.789 to 479.726)	104.375	205.558	128 (98)
Ireland	0.87375385	233.645 (147.899 to 354.516)	102.687	130.958	47 (36)
Israel	0.80901165	230.943 (143.206 to 357.405)	102.659	128.284	45 (35)
Italy	0.80577353	329.81 (214.458 to 476.138)	102.906	226.904	149 (113)
Jamaica	0.68326306	358.573 (255.899 to 493.668)	102.709	255.864	165 (137)
Japan	0.87124181	188.715 (114.886 to 288.402)	102.567	86.148	29 (22)
Jordan	0.72530723	308.669 (196.724 to 457.014)	102.646	206.023	130 (97)
Kazakhstan	0.7251445	285.712 (194.693 to 407.711)	102.92	182.792	105 (72)
Kenya	0.52376808	532.771 (379.718 to 719.399)	125.17	407.601	200 (199)
Kiribati	0.52718658	286.645 (210.14 to 381.31)	123.911	162.734	77 (74)
Kuwait	0.84665105	269.573 (168.431 to 413.3)	102.642	166.931	86 (63)
Kyrgyzstan	0.60397933	359.565 (237.372 to 521.902)	113.738	245.827	161 (140)
Lao People's Democratic Republic	0.48913609	213.025 (149.639 to 292.091)	167.566	45.459	12 (28)
Latvia	0.83066352	266.527 (165.399 to 406.388)	102.709	163.818	81 (58)
Lebanon	0.74474635	300.563 (182.9 to 468.056)	102.705	197.858	118 (88)
Lesotho	0.51039307	339.658 (258.507 to 439.263)	125.706	213.952	137 (122)
Liberia	0.35244245	390.552 (282.193 to 526.465)	236.614	153.938	70 (169)
Libya	0.7257714	299.341 (184.616 to 452.989)	102.633	196.708	116 (87)
Lithuania	0.85648405	325.887 (217.212 to 477.786)	102.702	223.185	145 (111)
Luxembourg	0.88442896	313.134 (194.514 to 487.318)	102.66	210.473	134 (101)
Madagascar	0.40024694	356.212 (253.665 to 481.537)	233.888	122.325	40 (135)
Malawi	0.38455363	367.508 (268.257 to 492.588)	232.898	134.611	50 (147)

Table 15 (continued)

Location	Prevalence				
	SDI	Age-standardized rate	Frontier prevalence	Effective difference	Effective difference rank (Age-standardized prevalence rank)
Malaysia	0.74252383	295.723 (221.407 to 388.566)	102.467	193.256	113 (83)
Maldives	0.65088663	201.428 (139.041 to 284.817)	108.127	93.301	32 (26)
Mali	0.26857994	419.659 (306.227 to 560.061)	263.327	156.332	72 (176)
Malta	0.80158503	267.657 (167.887 to 406.279)	102.671	164.986	82 (60)
Marshall Islands	0.57409113	295.718 (215.217 to 393.771)	117.454	178.263	100 (82)
Mauritania	0.4989451	313.146 (225.373 to 423.347)	127.492	185.654	107 (102)
Mauritius	0.71826045	108.612 (67.007 to 168.114)	102.548	6.064	2 (1)
Mexico	0.6645753	638.981 (476.444 to 837.021)	103.024	535.957	203 (203)
Micronesia (Federated States of)	0.58753497	261.792 (190.26 to 352.611)	116.013	145.779	62 (55)
Monaco	0.90826283	224.661 (139.942 to 351.954)	102.633	122.028	39 (32)
Mongolia	0.61762156	281.496 (182.432 to 411.47)	112.985	168.511	90 (69)
Montenegro	0.79580058	320.866 (195.033 to 506.436)	102.831	218.035	141 (109)
Morocco	0.5626983	318.941 (199.931 to 484.385)	118.49	200.451	120 (105)
Mozambique	0.32646261	433.071 (315.257 to 577.307)	239.112	193.959	114 (179)
Myanmar	0.53390084	205.242 (148.717 to 276.342)	123.779	81.463	28 (27)
Namibia	0.61756487	339.369 (251.301 to 448.663)	117.116	222.253	144 (121)
Nauru	0.62517783	186.271 (132.178 to 253.968)	108.294	77.977	26 (21)
Nepal	0.43317463	379.833 (276.493 to 506.95)	197.852	181.98	103 (158)
Netherlands	0.88846426	251.534 (160.288 to 387.177)	102.668	148.866	64 (46)
New Zealand	0.8494425	224.383 (147.65 to 322.135)	102.675	121.708	38 (31)
Nicaragua	0.52395847	449.685 (325.376 to 612.987)	126.004	323.68	188 (187)
Niger	0.16807277	453.382 (331.116 to 602.07)	359.092	94.29	34 (189)
Nigeria	0.50339083	473.874 (329.556 to 650.619)	125.69	348.184	196 (193)
Niue	0.72622205	193.217 (136.045 to 266.674)	102.671	90.546	30 (23)
North Macedonia	0.7506297	369.496 (241.429 to 549.693)	102.691	266.805	171 (150)
Northern Mariana Islands	0.77153521	132.222 (83.464 to 198.053)	102.784	29.438	8 (7)
Norway	0.91613281	237.579 (144.305 to 368.435)	102.523	135.056	51 (38)

Table 15 (continued)

Location	Prevalence				
	SDI	Age-standardized rate	Frontier prevalence	Effective difference	Effective difference rank (Age-standardized prevalence rank)
Oman	0.7733916	271.808 (162.922 to 427.205)	102.775	169.033	91 (64)
Pakistan	0.50402869	297.899 (200.29 to 417.31)	124.324	173.575	96 (85)
Palau	0.75404693	218.374 (154.706 to 299.734)	102.616	115.758	37 (30)
Palestine	0.63101167	342.401 (210.707 to 527.449)	107.972	234.43	153 (126)
Panama	0.70886483	364.799 (238.98 to 531.995)	102.976	261.824	168 (144)
Papua New Guinea	0.41779744	244.831 (170.501 to 338.38)	200.938	43.893	11 (43)
Paraguay	0.6357181	437.84 (313.001 to 591.973)	107.723	330.117	192 (181)
Peru	0.66205404	337.314 (229.914 to 479.778)	105	232.314	151 (119)
Philippines	0.65121933	239.995 (173.324 to 322.814)	106.311	133.684	49 (40)
Poland	0.81204281	316.818 (201.198 to 470.438)	102.646	214.172	138 (103)
Portugal	0.74415185	264.432 (178.403 to 377.378)	102.874	161.559	76 (56)
Puerto Rico	0.82552585	227.732 (146.169 to 339.337)	102.82	124.912	42 (33)
Qatar	0.84686058	331.339 (202.904 to 508.246)	102.551	228.788	150 (114)
Republic of Korea	0.88667527	172.482 (103.532 to 275.29)	102.604	69.878	24 (19)
Republic of Moldova	0.73221488	306.538 (206.102 to 446.918)	102.835	203.702	125 (93)
Romania	0.76845386	353.67 (229.966 to 519.932)	102.929	250.741	163 (133)
Russian Federation	0.808536	366.103 (243.224 to 524.601)	102.866	263.237	169 (145)
Rwanda	0.43558871	380.425 (272.743 to 516.829)	200.14	180.285	102 (159)
Saint Kitts and Nevis	0.75498705	348.13 (244.16 to 479.258)	102.898	245.232	160 (130)
Saint Lucia	0.67250974	308.246 (211.323 to 435.569)	102.98	205.265	127 (96)
Saint Vincent and the Grenadines	0.63719596	433.872 (320.843 to 580.848)	107.804	326.067	190 (180)
Samoa	0.59339277	240.67 (171.584 to 327.205)	114.114	126.556	44 (41)
San Marino	0.88800547	216.443 (128.211 to 346.328)	102.669	113.774	35 (29)
Sao Tome and Principe	0.50541375	293.782 (208.223 to 406.3)	124.144	169.638	92 (77)
Saudi Arabia	0.81514349	259.435 (156.911 to 404.5)	102.918	156.517	73 (53)
Senegal	0.40805419	385.242 (281.532 to 512.957)	206.095	179.147	101 (164)
Serbia	0.79241629	372.748 (257.202 to 533.662)	102.665	270.082	173 (153)

Table 15 (continued)

Location	Prevalence				
	SDI	Age-standardized rate	Frontier prevalence	Effective difference	Effective difference rank (Age-standardized prevalence rank)
Seychelles	0.73015077	138.691 (93.838 to 198.993)	102.816	35.875	9 (8)
Sierra Leone	0.35866588	383.811 (286.624 to 500.41)	239.032	144.778	61 (162)
Singapore	0.85609777	166.213 (101.725 to 262.714)	102.672	63.541	21 (17)
Slovakia	0.81061053	367.43 (243.105 to 536.753)	102.849	264.581	170 (146)
Slovenia	0.84243073	381.06 (251.522 to 563.064)	102.721	278.339	178 (160)
Solomon Islands	0.42936032	257.084 (186.705 to 350.637)	199.254	57.83	18 (51)
Somalia	0.07768811	368.502 (267.565 to 492.885)	359.707	8.796	3 (148)
South Africa	0.6796266	276.316 (199.603 to 371.216)	103.226	173.091	95 (67)
South Sudan	0.27837113	362.233 (257.535 to 493.78)	239.853	122.381	41 (141)
Spain	0.7692837	182.773 (126.592 to 256.449)	102.939	79.834	27 (20)
Sri Lanka	0.70153494	154.467 (105.869 to 220.925)	103.028	51.439	14 (10)
Sudan	0.54194974	362.469 (228.286 to 541.958)	125.449	237.02	154 (142)
Suriname	0.63366574	446.547 (330.362 to 594.391)	107.784	338.763	195 (185)
Sweden	0.8868803	195.055 (119.542 to 298.254)	102.644	92.411	31 (24)
Switzerland	0.93305911	294.912 (181.546 to 461.846)	102.298	192.614	112 (79)
Syrian Arab Republic	0.62300407	319.534 (196.966 to 494.913)	108.548	210.986	135 (107)
Taiwan (Province of China)	0.87474705	118.64 (76.84 to 175.484)	102.583	16.057	5 (3)
Tajikistan	0.54151119	334.859 (204.988 to 506.637)	124.531	210.329	133 (116)
Thailand	0.68254793	156.236 (108.362 to 219.821)	103.107	53.129	15 (12)
Timor-Leste	0.44466762	265.835 (183.23 to 372.873)	197.636	68.199	22 (57)
Togo	0.4085337	386.154 (285.63 to 509.873)	224.878	161.276	75 (165)
Tokelau	0.68642562	196.685 (136.441 to 276.528)	103.345	93.34	33 (25)
Tonga	0.62634994	276.745 (202.567 to 372.881)	108.365	168.38	89 (68)
Trinidad and Tobago	0.76876325	400.1 (289.868 to 540.675)	102.868	297.232	184 (173)
Tunisia	0.68243222	305.665 (188.085 to 474.078)	103.179	202.486	124 (91)
Turkey	0.71269267	320.779 (205.33 to 477.937)	102.646	218.133	142 (108)
Turkmenistan	0.68216078	325.233 (234.785 to 442.255)	102.982	222.251	143 (110)

Table 15 (continued)

Location	Prevalence				
	SDI	Age-standardized rate	Frontier prevalence	Effective difference	Effective difference rank (Age-standardized prevalence rank)
Tuvalu	0.57662053	255.161 (184.104 to 346.52)	114.528	140.633	57 (48)
Uganda	0.42326118	342.22 (248.837 to 458.079)	204.307	137.913	55 (125)
Ukraine	0.76077391	255.166 (155.95 to 389.063)	102.887	152.28	66 (49)
United Arab Emirates	0.84931773	275.65 (165.147 to 432.631)	102.658	172.992	94 (66)
United Kingdom	0.85900018	228.103 (157.334 to 317.439)	102.698	125.405	43 (34)
United Republic of Tanzania	0.44656827	328.663 (237.25 to 443.903)	199.259	129.404	46 (112)
United States Virgin Islands	0.82183085	295.135 (202.811 to 414.876)	102.817	192.318	111 (80)
United States of America	0.86244835	121.311 (76.201 to 182.767)	102.68	18.631	6 (5)
Uruguay	0.71928344	319.395 (222.632 to 444.305)	102.7	216.695	140 (106)
Uzbekistan	0.66262169	257.597 (168.959 to 375.491)	104.991	152.607	67 (52)
Vanuatu	0.47310071	316.933 (233.529 to 420.171)	181.408	135.524	52 (104)
Venezuela (Bolivarian Republic of)	0.59651306	442.309 (314.022 to 608.69)	118.287	324.022	189 (182)
Viet Nam	0.62793372	154.963 (104.531 to 220.052)	108.896	46.068	13 (11)
Yemen	0.45037638	457.652 (295.424 to 670.906)	199.065	258.587	167 (190)
Zambia	0.50594895	340.328 (251.017 to 452.097)	124.577	215.751	139 (123)
Zimbabwe	0.47381949	511.832 (390.92 to 657.562)	182.498	329.334	191 (197)

and an R2 value of 0.997.For prevalence prediction, the ARIMA model performed even better, with an MSE of 0.215, a MAPE of only 0.106%, an RMSE of 0.464, and an R2 value of 0.9998.For DALYs prediction, the ARIMA model had an MSE of 0.239, a MAPE of 0.450%, an RMSE of 0.488, and an R2 value of 0.997.For mortality prediction, the ARIMA model also performed well, with an MSE of only 0.00080, a MAPE of 0.788%, an RMSE of 0.028, and an R2 value of 0.995 (Fig. 15A, C, E, G).

In the prediction of absolute numbers, the ARIMA model also showed excellent performance. For the number of morbidities, the MSE of the ARIMA model was 14,376,076.55, the MAPE was 0.160%, the RMSE was 3,791.58, and the R2 value was as high as 0.9997. For the prediction of the number of illnesses, the MSE of the ARIMA model was 45,443,122.8, the MAPE was 0.103%, the RMSE was 6,741.15 with an R2 value of 0.9994.For the number of DALYs, the ARIMA model had an MSE of 32,253,111.85, a MAPE of 0.469%, an RMSE of 5,679.18, and an R2 value of 0.957.For the number of deaths prediction, the ARIMA model had an MSE of 93,870.36, a MAPE of 0.719%, an RMSE was 306.38 and R2 value was 0.932 (Fig. 16A,C,E,G).

Based on the results of the ARIMA model projections, we conducted a detailed analysis of the trends in the burden of disease from 2022 to 2050. In terms of incidence, the age-standardized rate is projected to increase slightly from 112.3187 in 2022 to 112.6377 (per 100,000 population) in 2050, with an average annual growth rate of only 0.01%. However, the absolute number of new cases is projected to increase from 2,764,122 in 2022 to 3,309,718 in 2050, an increase of 19.7% and an average annual growth rate of 0.64%. This difference reflects the impact of population growth and aging. In terms of prevalence, the age-standardized rate is projected to increase slightly from 280.9383 in 2022 to 284.1875 (per

Table 16 Frontier analysis of DALYs for Inguinal, Femoral, and Abdominal Hernia in 204 countries and territories for population aged 45 years and above, 2021

Location	DALYs				
	SDI	Age-standardized rate	Frontier DALYs	Effective difference	Effective difference rank (Age-standardized DALYs rank)
Afghanistan	0.3372	36.148 (20.124 to 59.388)	31.022	5.126	9 (59)
Albania	0.70684979	36.151 (20.609 to 58.193)	12.359	23.793	59 (60)
Algeria	0.65950092	24.209 (12.699 to 43.239)	12.795	11.413	22 (21)
American Samoa	0.72372753	69.753 (37.54 to 111.506)	11.494	58.259	147 (135)
Andorra	0.86944411	35.427 (20.538 to 56.92)	9.995	25.431	66 (57)
Angola	0.45372195	84.194 (46.442 to 143.104)	25.472	58.722	150 (159)
Antigua and Barbuda	0.74988689	48.408 (35.668 to 64.699)	10.313	38.095	107 (103)
Argentina	0.72312297	52.193 (40.317 to 66.757)	11.566	40.627	113 (112)
Armenia	0.70183319	64.865 (49.88 to 82.413)	11.946	52.919	135 (130)
Australia	0.84425281	34.345 (25.754 to 44.457)	9.786	24.558	61 (51)
Austria	0.853837	42.189 (28.438 to 60.869)	9.81	32.379	93 (87)
Azerbaijan	0.69485127	29.54 (17.931 to 45.624)	11.969	17.571	39 (35)
Bahamas	0.80502067	64.105 (48.491 to 83.618)	9.737	54.368	137 (127)
Bahrain	0.7530432	36.643 (22.567 to 56.317)	9.831	26.812	70 (64)
Bangladesh	0.49242088	73.715 (42.583 to 130.869)	21.574	52.141	134 (142)
Barbados	0.74674876	51.157 (36.866 to 69.358)	10.294	40.863	116 (110)
Belarus	0.78448471	46.701 (32.198 to 65.452)	9.807	36.894	105 (100)
Belgium	0.85365402	38.817 (26.539 to 55.554)	9.812	29.005	78 (73)
Belize	0.610229	71.8 (56.249 to 91.751)	12.704	59.096	152 (139)
Benin	0.37348657	85.726 (45.833 to 210.336)	29.747	55.978	142 (162)
Bermuda	0.82136542	50.583 (37.792 to 67.59)	9.795	40.788	114 (106)
Bhutan	0.47306238	79.223 (43.925 to 182.384)	21.212	58.012	146 (148)
Bolivia (Plurinational State of)	0.5990108	82.609 (50.11 to 127.264)	12.828	69.781	170 (154)
Bosnia and Herzegovina	0.72307789	44.991 (29.313 to 65.994)	11.531	33.46	95 (97)
Botswana	0.64272163	71.638 (45.975 to 110.165)	12.649	58.989	151 (138)
Brazil	0.65304389	106.413 (90.702 to 123.983)	12.79	93.623	192 (184)

Table 16 (continued)

Location	DALYs				
	SDI	Age-standardized rate	Frontier DALYs	Effective difference	Effective difference rank (Age-standardized DALYs rank)
Brunei Darussalam	0.81023437	21.349 (12.742 to 33.235)	9.764	11.585	24 (15)
Bulgaria	0.76815094	46.778 (32.652 to 66.457)	9.767	37.012	106 (101)
Burkina Faso	0.2851184	98.683 (54.199 to 246.333)	37.338	61.345	157 (175)
Burundi	0.28937436	106.994 (58.232 to 248.437)	37.288	69.706	169 (185)
Cabo Verde	0.53353454	54.807 (31.485 to 110.586)	14.001	40.805	115 (116)
Cambodia	0.47362149	76.967 (46.14 to 123.435)	22.249	54.717	138 (145)
Cameroon	0.47969122	73.497 (42.478 to 139.519)	22.912	50.585	130 (140)
Canada	0.87317068	33.241 (25.978 to 41.62)	9.924	23.317	54 (47)
Central African Republic	0.30916769	126.281 (66.208 to 226.833)	35.168	91.114	190 (198)
Chad	0.24043602	120.392 (63.814 to 313.019)	37.599	82.793	184 (189)
Chile	0.77151472	58.217 (45.32 to 74.221)	9.819	48.398	126 (119)
China	0.72162976	11.849 (7.388 to 18.103)	11.587	0.262	3 (2)
Colombia	0.65544291	73.821 (56.084 to 96.131)	12.841	60.98	156 (143)
Comoros	0.47597869	91 (51.058 to 190.518)	20.48	70.52	171 (168)
Congo	0.58307524	78.962 (44.65 to 131.89)	12.794	66.168	162 (146)
Cook Islands	0.77910995	34.134 (19.949 to 54.316)	9.774	24.36	60 (50)
Costa Rica	0.70034048	80.107 (62.738 to 100.991)	12.202	67.905	166 (150)
Coted'Ivoire	0.42594188	83.928 (48.483 to 170.834)	25.598	58.33	148 (158)
Croatia	0.79834103	46.175 (33.815 to 62.299)	9.939	36.236	104 (99)
Cuba	0.66872986	84.608 (66.346 to 106.766)	12.786	71.822	173 (161)
Cyprus	0.83563055	39.918 (24.588 to 62.423)	9.744	30.174	82 (78)
Czechia	0.82845043	41.273 (28.375 to 59.45)	9.924	31.349	89 (84)
Democratic People's Republic of Korea	0.56985463	12.967 (7.025 to 21.693)	12.71	0.257	2 (3)
Democratic Republic of the Congo	0.38317985	90.378 (48.732 to 168.24)	29.768	60.61	154 (167)
Denmark	0.8964242	41.878 (30.961 to 55.329)	9.856	32.022	90 (85)
Djibouti	0.48795837	92.777 (52.236 to 183.74)	20.768	72.009	174 (170)

Table 16 (continued)

Location	DALYs				
	SDI	Age-standardized rate	Frontier DALYs	Effective difference	Effective difference rank (Age-standardized DALYs rank)
Dominica	0.74696718	54.36 (35.619 to 79.485)	10.29	44.07	120 (114)
Dominican Republic	0.6193882	52.017 (31.028 to 81.039)	12.826	39.19	111 (111)
Ecuador	0.66101705	70.07 (53.144 to 89.777)	12.703	57.367	145 (137)
Egypt	0.60678709	31.699 (18.843 to 50.034)	12.667	19.032	40 (43)
El Salvador	0.56377519	124.049 (87.602 to 172.553)	13.316	110.733	199 (195)
Equatorial Guinea	0.65785746	61.263 (34.966 to 100.843)	12.772	48.491	127 (124)
Eritrea	0.40386394	125.312 (69.059 to 252.251)	29.513	95.799	195 (196)
Estonia	0.84491779	31.984 (21.49 to 46.877)	9.866	22.118	48 (44)
Eswatini	0.58545971	89.04 (54.363 to 143.195)	12.625	76.415	181 (165)
Ethiopia	0.3588233	88.516 (53.814 to 197.097)	29.989	58.527	149 (164)
Fiji	0.67505163	38.264 (23.223 to 59.914)	12.718	25.546	67 (71)
Finland	0.85983137	37.049 (26.694 to 51.33)	9.931	27.119	72 (66)
France	0.83836488	39.063 (27.678 to 54.356)	9.804	29.259	79 (74)
Gabon	0.63469139	60.713 (36.128 to 94.246)	12.664	48.048	125 (123)
Gambia	0.40971416	103.519 (57.472 to 217.779)	28.383	75.136	177 (180)
Georgia	0.7324736	58.264 (43.525 to 75.642)	11.24	47.024	123 (120)
Germany	0.90295709	40.461 (27.855 to 58.385)	9.808	30.653	85 (82)
Ghana	0.56493039	79.139 (47.636 to 140.989)	13.351	65.788	161 (147)
Greece	0.79185441	19.508 (13.166 to 28.054)	9.764	9.744	15 (10)
Greenland	0.82621034	42.229 (27.17 to 60.854)	9.984	32.246	91 (88)
Grenada	0.66899303	83.76 (65.9 to 106.014)	12.792	70.968	172 (157)
Guam	0.8039822	16.38 (9.778 to 25.441)	9.865	6.515	11 (6)
Guatemala	0.53997242	221.596 (181.038 to 269.839)	13.991	207.605	204 (204)
Guinea	0.33640129	94.318 (51.155 to 216.21)	30.888	63.43	159 (173)
Guinea-Bissau	0.35310962	125.416 (70.558 to 241.113)	30.274	95.141	193 (197)
Guyana	0.65081234	108.102 (81.163 to 141.152)	12.695	95.406	194 (186)
Haiti	0.44827828	136.289 (83.849 to 214.148)	25.741	110.548	198 (200)

Table 16 (continued)

Location	DALYs				
	SDI	Age-standardized rate	Frontier DALYs	Effective difference	Effective difference rank (Age-standardized DALYs rank)
Honduras	0.51303725	190.603 (110.167 to 296.813)	14.29	176.314	201 (201)
Hungary	0.79075477	49.589 (35.934 to 67.493)	9.748	39.841	112 (104)
Iceland	0.87636168	24.381 (17.02 to 34.224)	9.766	14.615	34 (23)
India	0.57540165	92.468 (67.35 to 124.641)	12.783	79.685	183 (169)
Indonesia	0.65686834	212.749 (142.594 to 280.577)	12.846	199.903	203 (203)
Iran (Islamic Republic of)	0.6972074	19.732 (11.618 to 31.38)	12.221	7.511	13 (11)
Iraq	0.66262623	24.228 (13.204 to 41.901)	12.791	11.437	23 (22)
Ireland	0.87375385	33.423 (23.339 to 47.055)	9.86	23.564	57 (49)
Israel	0.80901165	35.365 (24.44 to 49.956)	9.752	25.613	68 (55)
Italy	0.80577353	38.279 (27.909 to 51.866)	9.837	28.442	77 (72)
Jamaica	0.68326306	67.665 (50.385 to 90.554)	12.577	55.088	141 (133)
Japan	0.87124181	20.124 (13.58 to 28.821)	9.857	10.267	16 (12)
Jordan	0.72530723	22.648 (12.144 to 37.574)	11.753	10.895	21 (17)
Kazakhstan	0.7251445	42.601 (30.946 to 57.576)	11.567	31.034	88 (89)
Kenya	0.52376808	106.198 (70.482 to 204.545)	13.988	92.21	191 (183)
Kiribati	0.52718658	39.354 (23.189 to 65.147)	13.992	25.362	65 (75)
Kuwait	0.84665105	23.254 (13.442 to 37.319)	9.765	13.49	32 (19)
Kyrgyzstan	0.60397933	35.367 (23.091 to 52.559)	12.82	22.546	51 (56)
Lao People's Democratic Republic	0.48913609	54.733 (30.75 to 100.09)	19.095	35.638	102 (115)
Latvia	0.83066352	39.652 (28.788 to 54.007)	9.788	29.864	81 (77)
Lebanon	0.74474635	30.077 (17.494 to 47.843)	10.295	19.782	45 (40)
Lesotho	0.51039307	120.583 (70.534 to 192.181)	14.196	106.388	197 (190)
Liberia	0.35244245	84.355 (45.157 to 210.478)	30.088	54.267	136 (160)
Libya	0.7257714	24.989 (13.02 to 42.734)	11.805	13.184	30 (25)
Lithuania	0.85648405	50.736 (37.92 to 67.291)	9.86	40.875	117 (107)
Luxembourg	0.88442896	40.116 (27.085 to 57.706)	9.761	30.354	83 (79)

Table 16 (continued)

Location	DALYs				
	SDI	Age-standardized rate	Frontier DALYs	Effective difference	Effective difference rank (Age-standardized DALYs rank)
Madagascar	0.40024694	99.049 (52.412 to 246.933)	29.343	69.706	168 (176)
Malawi	0.38455363	96.118 (55.884 to 197.296)	29.753	66.365	163 (174)
Malaysia	0.74252383	83.467 (53.288 to 125.051)	10.427	73.04	175 (156)
Maldives	0.65088663	40.362 (25.455 to 60.869)	12.705	27.657	76 (80)
Mali	0.26857994	121.383 (62.067 to 306.854)	37.586	83.797	185 (192)
Malta	0.80158503	45.183 (32.481 to 61.747)	9.822	35.361	101 (98)
Marshall Islands	0.57409113	43.399 (25.457 to 69.931)	12.696	30.703	86 (91)
Mauritania	0.4989451	73.863 (39.474 to 175.525)	14.687	59.176	153 (144)
Mauritius	0.71826045	17.438 (12.408 to 24.085)	11.765	5.673	10 (8)
Mexico	0.6645753	128.943 (107.807 to 153.854)	12.797	116.145	200 (199)
Micronesia (Federated States of)	0.58753497	36.286 (21.89 to 57.625)	12.828	23.458	56 (61)
Monaco	0.90826283	29.699 (17.076 to 48.588)	9.785	19.914	46 (37)
Mongolia	0.61762156	36.575 (23.342 to 54.855)	12.841	23.735	58 (62)
Montenegro	0.79580058	29.612 (17.056 to 46.862)	9.855	19.758	44 (36)
Morocco	0.5626983	25.951 (13.947 to 44.142)	13.327	12.624	28 (28)
Mozambique	0.32646261	120.964 (69.306 to 234.438)	30.951	90.013	187 (191)
Myanmar	0.53390084	52.876 (30.381 to 92.454)	13.988	38.888	110 (113)
Namibia	0.61756487	103.146 (64.075 to 163.807)	12.779	90.367	188 (178)
Nauru	0.62517783	32.746 (15.317 to 53.553)	12.679	20.066	47 (46)
Nepal	0.43317463	80.593 (48.211 to 144.88)	25.709	54.884	140 (151)
Netherlands	0.88846426	42.165 (30.368 to 57.9)	9.792	32.372	92 (86)
New Zealand	0.8494425	40.574 (30.635 to 52.818)	9.865	30.709	87 (83)
Nicaragua	0.52395847	89.396 (64.472 to 121.751)	13.996	75.4	178 (166)
Niger	0.16807277	123.274 (58.522 to 392.334)	93.852	29.422	80 (194)
Nigeria	0.50339083	81.666 (53.642 to 156.09)	14.229	67.437	164 (152)
Niue	0.72622205	24.6 (14.943 to 38.039)	11.297	13.303	31 (24)
North Macedonia	0.7506297	44.647 (28.925 to 66.565)	10.191	34.456	97 (95)

Table 16 (continued)

Location	DALYs				
	SDI	Age-standardized rate	Frontier DALYs	Effective difference	Effective difference rank (Age-standardized DALYs rank)
Northern Mariana Islands	0.77153521	10.265 (4.932 to 18.067)	9.9	0.365	4 (1)
Norway	0.91613281	37.199 (27.8 to 48.81)	9.819	27.38	73 (67)
Oman	0.7733916	22.484 (11.674 to 38.647)	9.864	12.62	27 (16)
Pakistan	0.50402869	64.355 (42.447 to 98.234)	14.215	50.14	129 (128)
Palau	0.75404693	25.171 (15.182 to 38.977)	10.002	15.169	35 (26)
Palestine	0.63101167	35.145 (20.779 to 54.416)	12.822	22.324	49 (53)
Panama	0.70886483	79.677 (59.092 to 104.445)	12.198	67.479	165 (149)
Papua New Guinea	0.41779744	27.785 (14.823 to 55.865)	25.452	2.333	5 (31)
Paraguay	0.6357181	211.751 (148.254 to 294.43)	12.811	198.94	202 (202)
Peru	0.66205404	51.102 (32.736 to 75.625)	12.743	38.359	109 (109)
Philippines	0.65121933	58.869 (45.715 to 75.023)	12.839	46.029	122 (121)
Poland	0.81204281	43.047 (32.619 to 56.892)	9.811	33.235	94 (90)
Portugal	0.74415185	44.543 (32.936 to 59.417)	10.512	34.031	96 (93)
Puerto Rico	0.82552585	33.373 (23.854 to 46.355)	9.993	23.38	55 (48)
Qatar	0.84686058	35.268 (18.442 to 61.793)	9.949	25.319	64 (54)
Republic of Korea	0.88667527	16.47 (9.102 to 27.569)	9.859	6.611	12 (7)
Republic of Moldova	0.73221488	55.693 (42.349 to 73.529)	11.714	43.979	119 (117)
Romania	0.76845386	40.458 (27.96 to 57.998)	9.82	30.638	84 (81)
Russian Federation	0.808536	61.586 (50.169 to 76.067)	9.985	51.601	132 (125)
Rwanda	0.43558871	105.119 (56.038 to 261.537)	25.482	79.637	182 (182)
Saint Kitts and Nevis	0.75498705	64.819 (47.418 to 85.635)	9.943	54.876	139 (129)
Saint Lucia	0.67250974	51.003 (37.306 to 69.612)	12.73	38.273	108 (108)
Saint Vincent and the Grenadines	0.63719596	101.67 (81.526 to 126.69)	12.663	89.007	186 (177)
Samoa	0.59339277	29.925 (18.11 to 48.801)	12.81	17.115	38 (39)
San Marino	0.88800547	20.657 (10.42 to 35.931)	9.861	10.796	20 (14)
Sao Tome and Principe	0.50541375	65.316 (38.035 to 125.599)	14.297	51.019	131 (131)

Table 16 (continued)

Location	DALYs				
	SDI	Age-standardized rate	Frontier DALYs	Effective difference	Effective difference rank (Age-standardized DALYs rank)
Saudi Arabia	0.81514349	20.5 (10.732 to 34.91)	9.78	10.72	19 (13)
Senegal	0.40805419	94.071 (53.301 to 194.856)	29.56	64.511	160 (172)
Serbia	0.79241629	58.957 (41.014 to 82.251)	9.806	49.151	128 (122)
Seychelles	0.73015077	15.091 (8.638 to 24.295)	11.406	3.685	6 (5)
Sierra Leone	0.35866588	93.189 (50.246 to 233.422)	29.827	63.361	158 (171)
Singapore	0.85609777	17.737 (10.913 to 27.938)	9.76	7.976	14 (9)
Slovakia	0.81061053	44.57 (29.709 to 65.005)	10	34.571	98 (94)
Slovenia	0.84243073	44.448 (30.474 to 62.756)	9.814	34.635	99 (92)
Solomon Islands	0.42936032	30.534 (17.247 to 54.372)	26.011	4.523	8 (41)
Somalia	0.07768811	114.524 (54.651 to 270.445)	114.524	0	1 (188)
South Africa	0.6796266	73.594 (58.684 to 90.254)	12.636	60.958	155 (141)
South Sudan	0.27837113	112.327 (59.722 to 270.308)	38.682	73.646	176 (187)
Spain	0.7692837	37.437 (28.032 to 48.524)	9.948	27.489	74 (69)
Sri Lanka	0.70153494	34.618 (21.366 to 52.776)	12.243	22.375	50 (52)
Sudan	0.54194974	29.737 (16.55 to 49.82)	13.988	15.749	36 (38)
Suriname	0.63366574	88.189 (58.08 to 130.181)	12.636	75.553	180 (163)
Sweden	0.8868803	28.859 (20.49 to 39.966)	9.808	19.051	41 (32)
Switzerland	0.93305911	36.614 (24.152 to 53.701)	9.839	26.775	69 (63)
Syrian Arab Republic	0.62300407	25.963 (13.585 to 44.3)	12.807	13.156	29 (29)
Taiwan (Province of China)	0.87474705	13.597 (8.764 to 20.505)	9.787	3.81	7 (4)
Tajikistan	0.54151119	30.77 (17.389 to 49.192)	13.992	16.779	37 (42)
Thailand	0.68254793	37.701 (23.488 to 58.047)	12.663	25.038	63 (70)
Timor-Leste	0.44466762	70.043 (35.67 to 160.649)	25.43	44.613	121 (136)
Togo	0.4085337	105.074 (60.921 to 223.737)	29.565	75.509	179 (181)
Tokelau	0.68642562	26.883 (16.095 to 43.191)	12.579	14.304	33 (30)
Tonga	0.62634994	39.528 (23.916 to 66.146)	12.692	26.836	71 (76)
Trinidad and Tobago	0.76876325	61.76 (45.299 to 82.582)	9.9	51.86	133 (126)

Table 16 (continued)

Location	DALYs				
	SDI	Age-standardized rate	Frontier DALYs	Effective difference	Effective difference rank (Age-standardized DALYs rank)
Tunisia	0.68243222	23.121 (12.115 to 40.138)	12.683	10.438	17 (18)
Turkey	0.71269267	36.893 (23.046 to 56.425)	12.165	24.728	62 (65)
Turkmenistan	0.68216078	48.304 (35.678 to 64.393)	12.659	35.644	103 (102)
Tuvalu	0.57662053	35.609 (21.221 to 56.698)	12.801	22.808	53 (58)
Uganda	0.42326118	66.619 (39.306 to 110.758)	25.492	41.128	118 (132)
Ukraine	0.76077391	32.443 (21.987 to 46.061)	9.804	22.639	52 (45)
United Arab Emirates	0.84931773	44.963 (25.032 to 75.343)	9.807	35.155	100 (96)
United Kingdom	0.85900018	57.786 (48.399 to 67.605)	9.932	47.854	124 (118)
United Republic of Tanzania	0.44656827	82.218 (46.694 to 173.598)	25.535	56.683	144 (153)
United States Virgin Islands	0.82183085	29.537 (18.078 to 44.887)	9.854	19.684	43 (34)
United States of America	0.86244835	29.454 (24.334 to 35.406)	9.856	19.598	42 (33)
Uruguay	0.71928344	68.101 (54.245 to 85.501)	11.498	56.603	143 (134)
Uzbekistan	0.66262169	25.393 (16.129 to 37.521)	12.85	12.543	26 (27)
Vanuatu	0.47310071	50.168 (27.308 to 107.762)	22.551	27.617	75 (105)
Venezuela (Bolivarian Republic of)	0.59651306	103.31 (76.065 to 135.826)	12.832	90.478	189 (179)
Viet Nam	0.62793372	23.294 (13.3 to 36.893)	12.826	10.468	18 (20)
Yemen	0.45037638	37.269 (21.656 to 60.929)	25.429	11.84	25 (68)
Zambia	0.50594895	83.249 (51.218 to 131.257)	14.394	68.855	167 (155)
Zimbabwe	0.47381949	122.608 (74.186 to 190.528)	21.456	101.152	196 (193)

100,000 population) in 2050, with an average annual growth rate of 0.04%. Correspondingly, the total prevalence is projected to increase significantly from 6,876,557 in 2022 to 8,150,140 in 2050, an increase of 18.5% and a CAGR of 0.60%. For DALYs, the age-standardized rate is projected to gradually increase from 51.1910 in 2022 to 56.6707 (per 100,000) in 2050, showing a steady upward trend with an average annual growth rate of about 0.35%. In absolute numbers, DALYs are projected to increase from 1,218,787 in 2022 to 1,364,628 in 2050, an increase of about 12.0%, with a CAGR of 0.39%. In terms of mortality, the age-standardized rate is projected to gradually increase from 1.8386 in 2022 to 2.1095 (per 100,000 population) in 2050, with an average annual growth rate of about 0.49%. The number of deaths is projected to rise from 42,195 in 2022 to 45,779 in 2050, an increase of 8.5% and an average annual growth rate of 0.28%. These projections suggest that, despite relatively slow increases in age-standardized rates, the absolute burden of hernia-related disease will continue to increase over the next 30 years as a result of population growth and aging. In particular, the significant increase in the number of new

Table 17 Frontier analysis of mortality for Inguinal, Femoral, and Abdominal Hernia in 204 countries and territories for population aged 45 years and above, 2021

Location	Mortality				
	SDI	Age-standardized rate	Frontier mortality	Effective difference	Effective difference rank (Age-standardized mortality rank)
Afghanistan	0.3372	0.558 (0.237 to 1.265)	0.367	0.191	15 (25)
Albania	0.70684979	0.829 (0.469 to 1.396)	0.125	0.704	47 (47)
Algeria	0.65950092	0.251 (0.111 to 0.636)	0.148	0.102	7 (8)
American Samoa	0.72372753	2.56 (0.956 to 4.57)	0.085	2.475	137 (132)
Andorra	0.86944411	1.39 (0.753 to 2.322)	0.06	1.329	83 (81)
Angola	0.45372195	3.319 (1.391 to 6.536)	0.278	3.041	157 (158)
Antigua and Barbuda	0.74988689	1.593 (1.238 to 1.963)	0.064	1.53	94 (93)
Argentina	0.72312297	1.827 (1.5 to 2.16)	0.077	1.75	111 (109)
Armenia	0.70183319	2.171 (1.728 to 2.605)	0.14	2.03	122 (121)
Australia	0.84425281	1.652 (1.304 to 1.971)	0.06	1.592	99 (96)
Austria	0.853837	1.199 (0.954 to 1.414)	0.061	1.139	69 (66)
Azerbaijan	0.69485127	0.586 (0.309 to 1.042)	0.142	0.443	29 (31)
Bahamas	0.80502067	2.14 (1.642 to 2.742)	0.06	2.079	125 (120)
Bahrain	0.7530432	1.196 (0.754 to 1.796)	0.06	1.136	68 (65)
Bangladesh	0.49242088	3.006 (1.594 to 5.872)	0.272	2.733	143 (145)
Barbados	0.74674876	1.687 (1.203 to 2.214)	0.075	1.612	100 (97)
Belarus	0.78448471	1.411 (1.005 to 1.844)	0.06	1.351	86 (83)
Belgium	0.85365402	1.279 (0.997 to 1.53)	0.06	1.219	75 (73)
Belize	0.610229	2.571 (2.059 to 3.136)	0.152	2.419	135 (133)
Benin	0.37348657	3.566 (1.561 to 10.413)	0.346	3.22	166 (165)
Bermuda	0.82136542	1.894 (1.471 to 2.389)	0.06	1.834	118 (116)
Bhutan	0.47306238	3.459 (1.686 to 9.101)	0.265	3.194	165 (163)
Bolivia (Plurinational State of)	0.5990108	2.905 (1.378 to 4.993)	0.153	2.751	144 (140)
Bosnia and Herzegovina	0.72307789	1.252 (0.852 to 1.83)	0.075	1.177	73 (71)
Botswana	0.64272163	2.704 (1.543 to 4.56)	0.149	2.555	139 (136)
Brazil	0.65304389	4.129 (3.577 to 4.536)	0.148	3.981	185 (180)

Table 17 (continued)

Location	Mortality				
	SDI	Age-standardized rate	Frontier mortality	Effective difference	Effective difference rank (Age-standardized mortality rank)
Brunei Darussalam	0.81023437	0.7 (0.417 to 1.096)	0.061	0.639	44 (37)
Bulgaria	0.76815094	1.158 (0.913 to 1.431)	0.059	1.099	66 (62)
Burkina Faso	0.2851184	3.861 (1.659 to 11.646)	0.382	3.478	171 (174)
Burundi	0.28937436	4.317 (1.929 to 11.877)	0.382	3.935	182 (183)
Cabo Verde	0.53353454	2.124 (1.023 to 5.237)	0.257	1.866	120 (118)
Cambodia	0.47362149	3.306 (1.761 to 5.602)	0.265	3.041	156 (155)
Cameroon	0.47969122	3.028 (1.502 to 6.782)	0.256	2.772	146 (146)
Canada	0.87317068	1.734 (1.399 to 2.065)	0.061	1.673	104 (101)
Central African Republic	0.30916769	4.915 (1.903 to 10.911)	0.374	4.541	194 (193)
Chad	0.24043602	4.926 (2.033 to 15.666)	0.404	4.522	193 (194)
Chile	0.77151472	2.248 (1.846 to 2.648)	0.06	2.188	128 (125)
China	0.72162976	0.234 (0.172 to 0.305)	0.086	0.148	12 (6)
Colombia	0.65544291	2.621 (2.057 to 3.241)	0.148	2.473	136 (135)
Comoros	0.47597869	3.809 (1.785 to 9.296)	0.256	3.552	176 (171)
Congo	0.58307524	3.286 (1.456 to 6.287)	0.158	3.128	162 (152)
Cook Islands	0.77910995	0.748 (0.306 to 1.58)	0.06	0.689	46 (41)
Costa Rica	0.70034048	3.101 (2.468 to 3.722)	0.117	2.984	152 (148)
Coted'Ivoire	0.42594188	3.376 (1.607 to 8.215)	0.298	3.077	158 (160)
Croatia	0.79834103	1.559 (1.248 to 1.889)	0.06	1.5	93 (92)
Cuba	0.66872986	3.311 (2.642 to 4.043)	0.149	3.162	164 (157)
Cyprus	0.83563055	1.862 (1.125 to 2.964)	0.061	1.802	116 (113)
Czechia	0.82845043	1.096 (0.918 to 1.277)	0.061	1.035	61 (59)
Democratic People's Republic of Korea	0.56985463	0.287 (0.133 to 0.543)	0.172	0.116	8 (10)
Democratic Republic of the Congo	0.38317985	3.613 (1.508 to 7.95)	0.344	3.269	167 (167)
Denmark	0.8964242	1.775 (1.424 to 2.109)	0.061	1.714	107 (103)
Djibouti	0.48795837	3.841 (1.836 to 8.608)	0.247	3.594	177 (172)

Table 17 (continued)

Location	Mortality				
	SDI	Age-standardized rate	Frontier mortality	Effective difference	Effective difference rank (Age-standardized mortality rank)
Dominica	0.74696718	1.859 (1.103 to 2.929)	0.072	1.787	114 (112)
Dominican Republic	0.6193882	1.804 (0.917 to 3.114)	0.148	1.656	102 (105)
Ecuador	0.66101705	2.506 (1.939 to 3.161)	0.151	2.355	134 (130)
Egypt	0.60678709	0.717 (0.409 to 1.196)	0.149	0.568	36 (39)
El Salvador	0.56377519	5.236 (3.48 to 7.521)	0.175	5.062	199 (197)
Equatorial Guinea	0.65785746	2.419 (1.103 to 4.546)	0.148	2.27	130 (128)
Eritrea	0.40386394	5.415 (2.524 to 12.81)	0.341	5.074	200 (200)
Estonia	0.84491779	0.816 (0.649 to 0.997)	0.058	0.758	48 (46)
Eswatini	0.58545971	3.471 (1.84 to 6.041)	0.162	3.309	168 (164)
Ethiopia	0.3588233	3.278 (1.693 to 9.063)	0.347	2.931	151 (151)
Fiji	0.67505163	1.212 (0.59 to 2.182)	0.143	1.068	63 (68)
Finland	0.85983137	1.353 (1.077 to 1.624)	0.058	1.294	80 (78)
France	0.83836488	1.547 (1.211 to 1.865)	0.06	1.487	92 (90)
Gabon	0.63469139	2.491 (1.222 to 4.31)	0.149	2.342	133 (129)
Gambia	0.40971416	4.357 (2.032 to 10.336)	0.336	4.021	187 (185)
Georgia	0.7324736	1.711 (1.292 to 2.197)	0.083	1.629	101 (99)
Germany	0.90295709	1.377 (1.089 to 1.651)	0.06	1.317	81 (79)
Ghana	0.56493039	3.309 (1.67 to 7.121)	0.176	3.133	163 (156)
Greece	0.79185441	0.64 (0.512 to 0.76)	0.059	0.581	37 (34)
Greenland	0.82621034	1.806 (1.064 to 2.741)	0.06	1.745	110 (106)
Grenada	0.66899303	2.914 (2.3 to 3.621)	0.148	2.766	145 (142)
Guam	0.8039822	0.316 (0.182 to 0.508)	0.058	0.257	20 (14)
Guatemala	0.53997242	10.289 (8.289 to 12.502)	0.255	10.034	203 (203)
Guinea	0.33640129	3.886 (1.763 to 10.534)	0.371	3.515	172 (176)
Guinea-Bissau	0.35310962	5.153 (2.461 to 11.825)	0.349	4.804	197 (196)
Guyana	0.65081234	3.7 (2.686 to 4.938)	0.149	3.551	175 (168)
Haiti	0.44827828	4.98 (2.529 to 8.952)	0.28	4.699	196 (195)

Table 17 (continued)

Location	Mortality				
	SDI	Age-standardized rate	Frontier mortality	Effective difference	Effective difference rank (Age-standardized mortality rank)
Honduras	0.51303725	7.817 (3.678 to 13.319)	0.253	7.564	201 (201)
Hungary	0.79075477	1.489 (1.202 to 1.818)	0.06	1.429	90 (86)
Iceland	0.87636168	1.004 (0.771 to 1.235)	0.06	0.944	58 (55)
India	0.57540165	3.59 (2.389 to 5.057)	0.171	3.42	169 (166)
Indonesia	0.65686834	10.451 (6.651 to 14.174)	0.148	10.303	204 (204)
Iran (Islamic Republic of)	0.6972074	0.233 (0.157 to 0.309)	0.108	0.124	9 (5)
Iraq	0.66262623	0.237 (0.115 to 0.54)	0.151	0.086	6 (7)
Ireland	0.87375385	1.208 (0.948 to 1.459)	0.061	1.148	70 (67)
Israel	0.80901165	1.451 (1.128 to 1.741)	0.06	1.39	88 (84)
Italy	0.80577353	1.122 (0.914 to 1.261)	0.06	1.062	62 (60)
Jamaica	0.68326306	2.262 (1.661 to 2.989)	0.144	2.118	127 (126)
Japan	0.87124181	0.585 (0.442 to 0.675)	0.06	0.526	34 (30)
Jordan	0.72530723	0.153 (0.099 to 0.226)	0.087	0.066	3 (2)
Kazakhstan	0.7251445	1.168 (0.889 to 1.496)	0.075	1.094	65 (64)
Kenya	0.52376808	4.188 (2.432 to 10.151)	0.244	3.943	183 (182)
Kiribati	0.52718658	1.057 (0.458 to 2.186)	0.252	0.806	52 (56)
Kuwait	0.84665105	0.35 (0.259 to 0.441)	0.061	0.289	22 (17)
Kyrgyzstan	0.60397933	0.563 (0.428 to 0.718)	0.155	0.408	27 (27)
Lao People's Democratic Republic	0.48913609	2.229 (1.027 to 4.521)	0.265	1.964	121 (124)
Latvia	0.83066352	1.231 (0.99 to 1.497)	0.06	1.171	72 (69)
Lebanon	0.74474635	0.655 (0.395 to 1.012)	0.073	0.581	39 (35)
Lesotho	0.51039307	4.618 (2.44 to 7.91)	0.261	4.357	190 (188)
Liberia	0.35244245	3.434 (1.432 to 10.622)	0.356	3.078	159 (162)
Libya	0.7257714	0.314 (0.123 to 0.712)	0.085	0.23	18 (13)
Lithuania	0.85648405	1.719 (1.388 to 2.071)	0.06	1.659	103 (100)
Luxembourg	0.88442896	1.381 (1.09 to 1.665)	0.06	1.321	82 (80)

Table 17 (continued)

Location	Mortality				
	SDI	Age-standardized rate	Frontier mortality	Effective difference	Effective difference rank (Age-standardized mortality rank)
Madagascar	0.40024694	4.15 (1.817 to 12.381)	0.341	3.808	180 (181)
Malawi	0.38455363	3.896 (1.928 to 9.269)	0.345	3.55	174 (177)
Malaysia	0.74252383	3.774 (2.125 to 6.088)	0.074	3.7	178 (169)
Maldives	0.65088663	1.864 (1.094 to 2.937)	0.149	1.716	108 (114)
Mali	0.26857994	5.287 (2.246 to 15.477)	0.385	4.902	198 (198)
Malta	0.80158503	1.8 (1.398 to 2.204)	0.06	1.739	109 (104)
Marshall Islands	0.57409113	1.314 (0.55 to 2.511)	0.164	1.15	71 (76)
Mauritania	0.4989451	3.147 (1.394 to 8.884)	0.254	2.892	150 (150)
Mauritius	0.71826045	0.575 (0.467 to 0.689)	0.087	0.488	31 (28)
Mexico	0.6645753	4.842 (4.199 to 5.482)	0.15	4.692	195 (192)
Micronesia (Federated States of)	0.58753497	0.976 (0.467 to 1.834)	0.157	0.819	53 (52)
Monaco	0.90826283	1.081 (0.571 to 1.859)	0.061	1.02	60 (58)
Mongolia	0.61762156	0.927 (0.567 to 1.434)	0.15	0.777	49 (49)
Montenegro	0.79580058	0.56 (0.364 to 0.809)	0.06	0.5	32 (26)
Morocco	0.5626983	0.301 (0.146 to 0.748)	0.176	0.125	10 (11)
Mozambique	0.32646261	4.754 (2.309 to 10.59)	0.369	4.385	191 (190)
Myanmar	0.53390084	1.816 (0.908 to 3.52)	0.246	1.57	96 (108)
Namibia	0.61756487	4.123 (2.298 to 7.197)	0.148	3.974	184 (179)
Nauru	0.62517783	1.064 (0.32 to 2.009)	0.148	0.916	55 (57)
Nepal	0.43317463	3.289 (1.689 to 6.846)	0.293	2.997	153 (153)
Netherlands	0.88846426	1.85 (1.469 to 2.208)	0.06	1.79	115 (111)
New Zealand	0.8494425	1.837 (1.467 to 2.179)	0.06	1.777	113 (110)
Nicaragua	0.52395847	3.335 (2.258 to 4.735)	0.252	3.082	160 (159)
Niger	0.16807277	5.358 (1.992 to 20.14)	3.665	1.693	106 (199)
Nigeria	0.50339083	3.081 (1.77 to 7.359)	0.256	2.825	147 (147)
Niue	0.72622205	0.657 (0.322 to 1.159)	0.075	0.581	38 (36)
North Macedonia	0.7506297	1.398 (0.96 to 1.991)	0.06	1.338	84 (82)

Table 17 (continued)

Location	Mortality				
	SDI	Age-standardized rate	Frontier mortality	Effective difference	Effective difference rank (Age-standardized mortality rank)
Northern Mariana Islands	0.77153521	0.089 (0.026 to 0.172)	0.06	0.029	2 (1)
Norway	0.91613281	1.639 (1.347 to 1.833)	0.059	1.581	98 (95)
Oman	0.7733916	0.272 (0.134 to 0.506)	0.06	0.212	17 (9)
Pakistan	0.50402869	2.604 (1.598 to 4.374)	0.268	2.336	132 (134)
Palau	0.75404693	0.588 (0.291 to 1.046)	0.06	0.527	35 (32)
Palestine	0.63101167	0.776 (0.472 to 1.188)	0.148	0.628	42 (45)
Panama	0.70886483	3.134 (2.318 to 3.985)	0.106	3.028	155 (149)
Papua New Guinea	0.41779744	0.614 (0.21 to 1.893)	0.313	0.301	23 (33)
Paraguay	0.6357181	10.058 (6.76 to 14.309)	0.149	9.91	202 (202)
Peru	0.66205404	1.495 (0.865 to 2.41)	0.148	1.346	85 (87)
Philippines	0.65121933	2.201 (1.592 to 2.848)	0.148	2.053	123 (123)
Poland	0.81204281	1.514 (1.31 to 1.679)	0.06	1.454	91 (88)
Portugal	0.74415185	1.892 (1.508 to 2.268)	0.074	1.818	117 (115)
Puerto Rico	0.82552585	0.995 (0.772 to 1.241)	0.061	0.934	57 (54)
Qatar	0.84686058	0.847 (0.382 to 1.789)	0.06	0.787	50 (48)
Republic of Korea	0.88667527	0.401 (0.264 to 0.592)	0.061	0.34	24 (18)
Republic of Moldova	0.73221488	1.928 (1.538 to 2.37)	0.073	1.855	119 (117)
Romania	0.76845386	0.983 (0.783 to 1.203)	0.059	0.923	56 (53)
Russian Federation	0.808536	2.133 (1.895 to 2.33)	0.06	2.073	124 (119)
Rwanda	0.43558871	4.558 (2.04 to 12.997)	0.289	4.269	189 (187)
Saint Kitts and Nevis	0.75498705	2.336 (1.731 to 2.988)	0.06	2.275	131 (127)
Saint Lucia	0.67250974	1.698 (1.251 to 2.207)	0.133	1.565	95 (98)
Saint Vincent and the Grenadines	0.63719596	3.86 (3.134 to 4.689)	0.151	3.709	179 (173)
Samoa	0.59339277	0.775 (0.388 to 1.539)	0.156	0.619	40 (43)
San Marino	0.88800547	0.506 (0.259 to 0.881)	0.06	0.446	30 (24)
Sao Tome and Principe	0.50541375	2.767 (1.405 to 6.239)	0.264	2.503	138 (137)

Table 17 (continued)

Location	Mortality				
	SDI	Age-standardized rate	Frontier mortality	Effective difference	Effective difference rank (Age-standardized mortality rank)
Saudi Arabia	0.81514349	0.215 (0.109 to 0.437)	0.06	0.154	13 (4)
Senegal	0.40805419	3.881 (1.836 to 9.085)	0.341	3.54	173 (175)
Serbia	0.79241629	2.179 (1.502 to 3.021)	0.061	2.118	126 (122)
Seychelles	0.73015077	0.33 (0.168 to 0.608)	0.081	0.249	19 (15)
Sierra Leone	0.35866588	3.784 (1.707 to 11.323)	0.351	3.433	170 (170)
Singapore	0.85609777	0.451 (0.354 to 0.54)	0.058	0.392	26 (23)
Slovakia	0.81061053	1.291 (0.896 to 1.823)	0.06	1.231	76 (74)
Slovenia	0.84243073	1.346 (1.071 to 1.621)	0.061	1.285	79 (77)
Solomon Islands	0.42936032	0.706 (0.276 to 1.733)	0.298	0.408	28 (38)
Somalia	0.07768811	4.668 (1.7 to 13.306)	4.668	0	1 (189)
South Africa	0.6796266	2.829 (2.226 to 3.47)	0.142	2.687	141 (139)
South Sudan	0.27837113	4.807 (2.175 to 13.129)	0.384	4.424	192 (191)
Spain	0.7692837	1.813 (1.407 to 2.183)	0.061	1.752	112 (107)
Sri Lanka	0.70153494	1.486 (0.849 to 2.387)	0.115	1.371	87 (85)
Sudan	0.54194974	0.334 (0.146 to 0.762)	0.253	0.082	5 (16)
Suriname	0.63366574	2.999 (1.709 to 4.894)	0.149	2.85	149 (144)
Sweden	0.8868803	1.135 (0.898 to 1.366)	0.059	1.076	64 (61)
Switzerland	0.93305911	1.241 (0.963 to 1.48)	0.057	1.183	74 (70)
Syrian Arab Republic	0.62300407	0.309 (0.149 to 0.742)	0.148	0.161	14 (12)
Taiwan (Province of China)	0.87474705	0.412 (0.324 to 0.499)	0.059	0.354	25 (20)
Tajikistan	0.54151119	0.45 (0.243 to 0.741)	0.245	0.205	16 (22)
Thailand	0.68254793	1.528 (0.871 to 2.527)	0.121	1.407	89 (89)
Timor-Leste	0.44466762	2.951 (1.194 to 7.804)	0.277	2.674	140 (143)
Togo	0.4085337	4.355 (2.135 to 11.088)	0.34	4.015	186 (184)
Tokelau	0.68642562	0.776 (0.389 to 1.453)	0.144	0.631	43 (44)
Tonga	0.62634994	1.16 (0.566 to 2.338)	0.148	1.012	59 (63)
Trinidad and Tobago	0.76876325	1.74 (1.225 to 2.343)	0.061	1.679	105 (102)

Table 17 (continued)

Location	Mortality				
	SDI	Age-standardized rate	Frontier mortality	Effective difference	Effective difference rank (Age-standardized mortality rank)
Tunisia	0.68243222	0.2 (0.098 to 0.443)	0.131	0.07	4 (3)
Turkey	0.71269267	0.976 (0.601 to 1.484)	0.1	0.876	54 (51)
Turkmenistan	0.68216078	1.252 (0.898 to 1.676)	0.12	1.132	67 (72)
Tuvalu	0.57662053	0.976 (0.465 to 1.859)	0.17	0.805	51 (50)
Uganda	0.42326118	2.514 (1.175 to 5.004)	0.302	2.212	129 (131)
Ukraine	0.76077391	0.745 (0.535 to 1.002)	0.061	0.684	45 (40)
United Arab Emirates	0.84931773	1.635 (0.885 to 2.875)	0.06	1.574	97 (94)
United Kingdom	0.85900018	2.908 (2.487 to 3.158)	0.058	2.85	148 (141)
United Republic of Tanzania	0.44656827	3.378 (1.629 to 8.337)	0.283	3.096	161 (161)
United States Virgin Islands	0.82183085	0.58 (0.31 to 0.963)	0.06	0.52	33 (29)
United States of America	0.86244835	1.307 (1.101 to 1.432)	0.06	1.247	77 (75)
Uruguay	0.71928344	2.782 (2.302 to 3.282)	0.086	2.697	142 (138)
Uzbekistan	0.66262169	0.419 (0.316 to 0.541)	0.148	0.271	21 (21)
Vanuatu	0.47310071	1.548 (0.58 to 4.613)	0.277	1.271	78 (91)
Venezuela (Bolivarian Republic of)	0.59651306	3.972 (2.83 to 5.28)	0.154	3.818	181 (178)
Viet Nam	0.62793372	0.771 (0.385 to 1.334)	0.148	0.623	41 (42)
Yemen	0.45037638	0.407 (0.183 to 0.908)	0.278	0.13	11 (19)
Zambia	0.50594895	3.294 (1.727 to 5.94)	0.269	3.025	154 (154)
Zimbabwe	0.47381949	4.383 (2.204 to 7.45)	0.274	4.109	188 (186)

cases and total prevalence predicts that the healthcare system is likely to come under even greater pressure. This continued increase in disease burden highlights the urgent need to strengthen preventive measures, improve treatments, and increase healthcare resource allocation to address this growing public health challenge. Future research should focus on the optimization of risk factors, preventive strategies, and treatments for hernia in order to reduce this growing disease burden.

Discussion

This study provides a comprehensive analysis of the global burden of inguinal, femoral, and abdominal wall hernias among adults aged 45 and older, offering critical insights into long-term trends, disparities, future projections, and—uniquely—health workforce correlations. The findings demonstrate that while age-standardized incidence and mortality rates have declined over the past three decades, the absolute burden of hernias continues to increase, driven primarily by population growth and aging. Our decomposition analysis quantifies this impact,

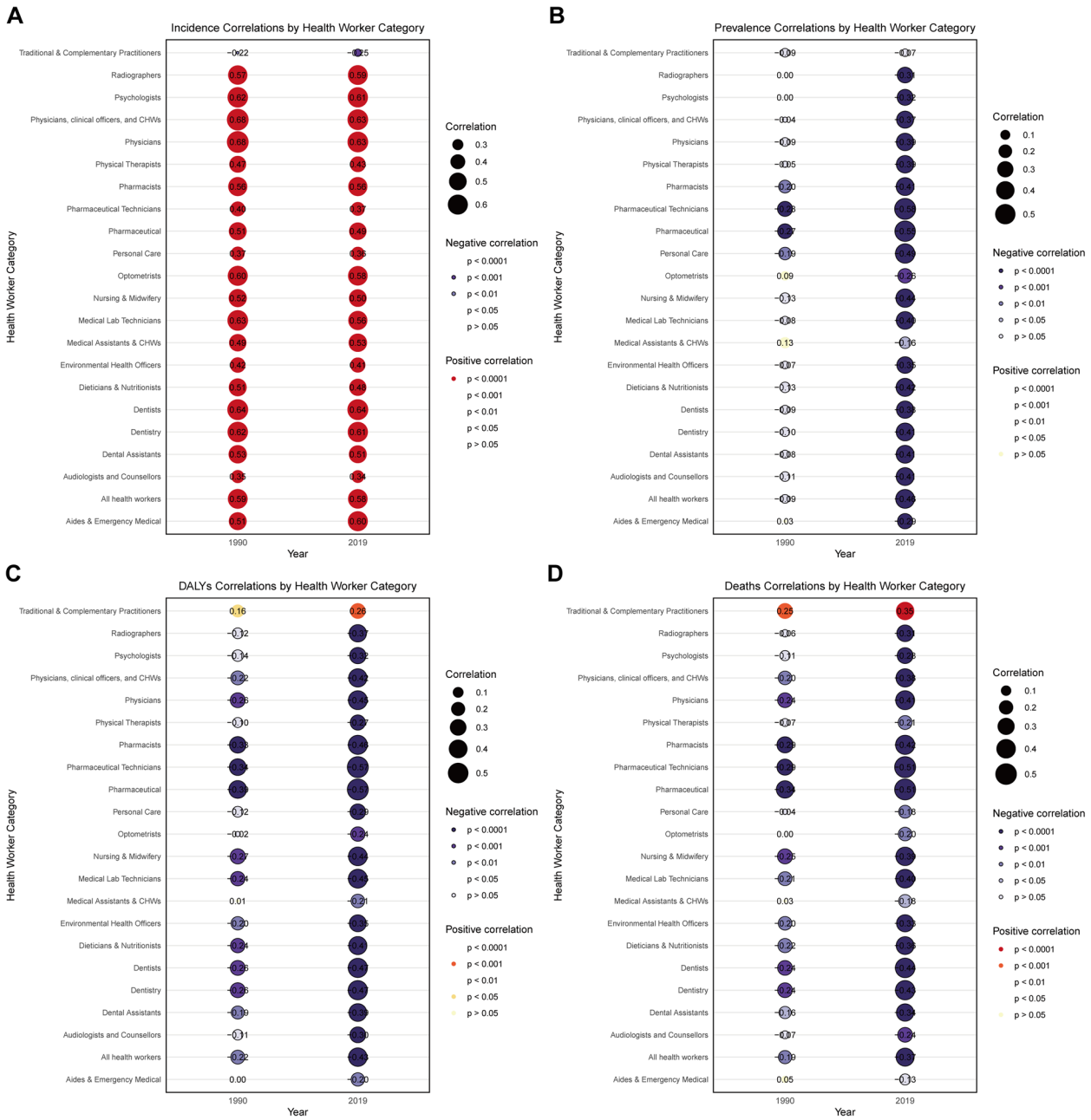

Fig. 15 Correlation trends between health workforce categories and hernia disease burden from 1990 to 2019

showing that population growth contributed 173.80% to the increased incidence, underscoring the demographic forces driving hernia epidemiology.

Our analysis reveals a strong correlation between population aging and the rising absolute burden of hernias. The highest incidence and prevalence were observed in the 65–69 age group (RR = 1.43, 95% CI: 1.42–1.43), with DALYs and mortality increasing significantly in individuals aged 90 and above. These age-related patterns stem from physiological mechanisms including declining connective tissue integrity with age, decreased collagen synthesis and quality, weakening of abdominal musculature, and cumulative effects of increased intra-abdominal pressure due to chronic conditions such as COPD, prostate hypertrophy, and constipation. These findings align with evidence linking hernia development to declining muscle integrity [18], comorbidities [19], and cumulative physical strain [20] in older adults. Given global aging

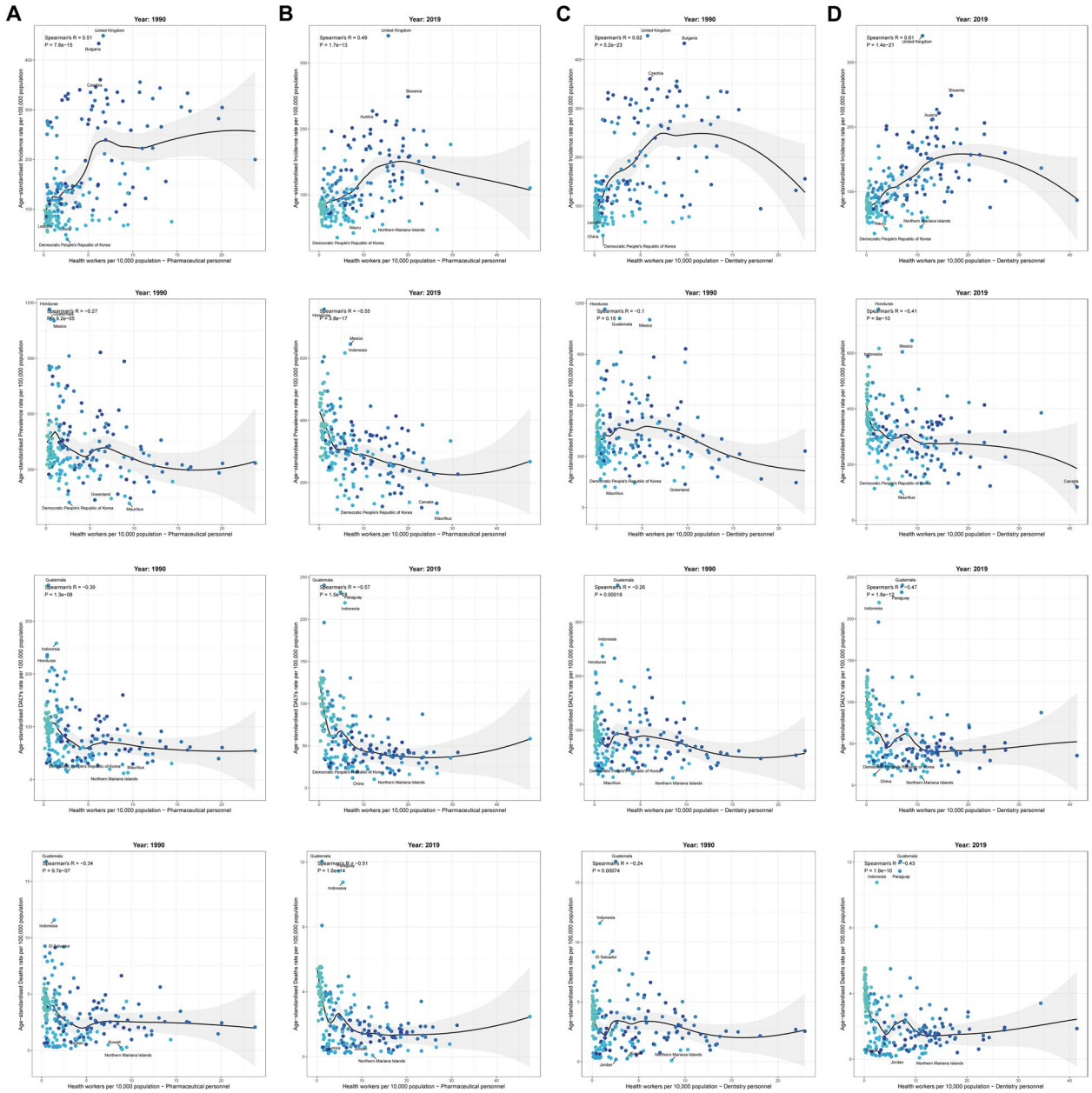

Fig. 16 Country-level variations in pharmaceutical and dentistry personnel distribution and hernia burden

trends, proactive measures, including routine screening and early surgical management [21, 22], are essential to mitigate the impact of hernias in elderly populations [23].

The analysis revealed stark disparities in hernia burden across socioeconomic strata. High-SDI regions reported higher age-standardized incidence rates (141.94/100,000) compared to low-SDI areas (104.60/100,000), but significantly lower mortality rates (1.23/100,000 versus 4.14/100,000 in low-SDI areas). This paradoxical pattern reflects better healthcare infrastructure, improved diagnostic capabilities, and access to timely surgical interventions in high-resource settings, while highlighting the critical challenges of limited surgical capacity and delayed care in resource-constrained environments. Within-country disparities also likely play a significant role, particularly in middle-income countries where healthcare access varies dramatically between urban and rural populations, though our country-level analysis cannot fully capture these nuances. These mortality differentials underscore how socioeconomic factors translate into

Table 18 Age-standardized rate projections for inguinal, femoral, and abdominal hernia using eight time series machine learning models incidence, prevalence, mortality, and DALYs (Both sexes combined, age 45 + Years)

Year	Prophet	ARIMA	TBATS	ElasticNet	ETS	VAR	HoltWinters	Theta	Metric
2022	51.1542	51.1910	50.8168	48.5609	52.0246	50.9473	51.2387	51.3138	DALYs
2023	50.6923	51.5456	50.2613	46.3639	49.9204	50.8086	51.2779	51.3592	DALYs
2024	50.3406	52.0685	49.7336	44.4660	48.1065	50.6950	51.2772	51.7140	DALYs
2025	50.0622	52.5416	49.2323	42.8189	47.1723	50.6020	51.2666	51.8894	DALYs
2026	49.7843	52.9697	48.7561	41.3838	44.8137	50.5258	51.2671	52.0306	DALYs
2027	49.5582	53.3570	48.3037	40.1288	44.1620	50.4635	51.2933	52.1393	DALYs
2028	49.3739	53.7075	47.8739	39.0276	43.6710	50.4124	51.3555	52.1921	DALYs
2029	49.2236	54.0246	47.4656	38.0586	41.8377	50.3706	51.4610	52.2112	DALYs
2030	49.1009	54.3115	47.0777	37.2035	42.0423	50.3364	51.6147	52.2503	DALYs
2031	49.0008	54.5712	46.7092	36.4472	41.7433	50.3084	51.8202	52.3811	DALYs
2032	48.9189	54.8061	46.3591	35.7768	40.3687	50.2855	52.0800	52.6125	DALYs
2033	48.8520	55.0187	46.0266	35.1814	40.6090	50.2667	52.3957	52.8614	DALYs
2034	48.7974	55.2110	45.7106	34.6516	40.4960	50.2513	52.7686	53.1028	DALYs
2035	48.7526	55.3851	45.4105	34.1794	38.4712	50.2387	53.1996	53.3154	DALYs
2036	48.7161	55.5426	45.1254	33.7580	36.5477	50.2284	53.6892	53.5438	DALYs
2037	48.6861	55.6851	44.8545	33.3813	35.4662	50.2200	54.2379	53.7422	DALYs
2038	48.6617	55.8140	44.5971	33.0444	33.6929	50.2131	54.8459	53.8505	DALYs
2039	48.6416	55.9307	44.3527	32.7425	32.5147	50.2074	55.5135	53.8730	DALYs
2040	48.6252	56.0362	44.1204	32.4719	32.0689	50.2028	56.2407	53.8391	DALYs
2041	48.6118	56.1317	43.8998	32.2291	30.4655	50.1990	57.0277	53.8016	DALYs
2042	48.6008	56.2182	43.6902	32.0110	30.4756	50.1959	57.8746	53.8277	DALYs
2043	48.5918	56.2964	43.4911	31.8150	30.1523	50.1934	58.7814	53.9482	DALYs
2044	48.5845	56.3671	43.3019	31.6387	28.7249	50.1913	59.7481	54.1801	DALYs
2045	48.5785	56.4312	43.1222	31.4801	28.9009	50.1896	60.7748	54.4436	DALYs
2046	48.5735	56.4891	42.9515	31.3373	28.7234	50.1882	61.8614	54.7286	DALYs
2047	48.5695	56.5415	42.7893	31.2087	27.2873	50.1870	63.0080	55.0007	DALYs
2048	48.5662	56.5889	42.6352	31.0928	25.9229	50.1861	64.2147	55.2358	DALYs
2049	48.5635	56.6319	42.4889	30.9883	24.6268	50.1853	65.4813	55.4047	DALYs
2050	48.5613	56.6707	42.3498	30.8941	23.3954	50.1847	66.7910	55.4830	DALYs
2022	1.8968	1.8386	1.8825	1.7802	1.8839	1.8500	1.8931	1.8706	Deaths
2023	1.8567	1.8466	1.8537	1.7083	1.8146	1.8390	1.9156	1.8722	Deaths
2024	1.8161	1.8573	1.8263	1.6458	1.7454	1.8300	1.9338	1.8854	Deaths
2025	1.7817	1.8708	1.8003	1.5914	1.7203	1.8227	1.9499	1.8918	Deaths
2026	1.7605	1.8875	1.7756	1.5438	1.6691	1.8167	1.9653	1.8969	Deaths
2027	1.7434	1.9077	1.7521	1.5020	1.6098	1.8118	1.9813	1.9008	Deaths
2028	1.7295	1.9291	1.7298	1.4652	1.5733	1.8077	1.9984	1.9027	Deaths
2029	1.7182	1.9484	1.7086	1.4327	1.5303	1.8044	2.0172	1.9033	Deaths
2030	1.7090	1.9659	1.6884	1.4040	1.4985	1.8017	2.0382	1.9046	Deaths
2031	1.7016	1.9817	1.6693	1.3785	1.4840	1.7995	2.0614	1.9094	Deaths
2032	1.6955	1.9960	1.6511	1.3558	1.4351	1.7977	2.0871	1.9178	Deaths
2033	1.6905	2.0089	1.6339	1.3357	1.4027	1.7962	2.1155	1.9269	Deaths
2034	1.6865	2.0206	1.6175	1.3177	1.3741	1.7950	2.1465	1.9358	Deaths
2035	1.6831	2.0312	1.6019	1.3017	1.3054	1.7940	2.1804	1.9436	Deaths
2036	1.6804	2.0408	1.5871	1.2874	1.2401	1.7932	2.2170	1.9520	Deaths
2037	1.6782	2.0495	1.5730	1.2745	1.2038	1.7925	2.2565	1.9592	Deaths
2038	1.6764	2.0574	1.5597	1.2631	1.1536	1.7920	2.2989	1.9631	Deaths
2039	1.6749	2.0645	1.5470	1.2528	1.0962	1.7915	2.3441	1.9639	Deaths
2040	1.6737	2.0709	1.5349	1.2435	1.0616	1.7912	2.3910	1.9625	Deaths

Table 18 (continued)

Year	Prophet	ARIMA	TBATS	ElasticNet	ETS	VAR	HoltWinters	Theta	Metric
2041	1.6727	2.0767	1.5235	1.2352	1.0200	1.7909	2.4388	1.9611	Deaths
2042	1.6719	2.0820	1.5126	1.2277	0.9886	1.7906	2.4876	1.9620	Deaths
2043	1.6713	2.0867	1.5022	1.2210	0.9730	1.7904	2.5373	1.9663	Deaths
2044	1.6707	2.0911	1.4924	1.2150	0.9243	1.7902	2.5881	1.9748	Deaths
2045	1.6703	2.0950	1.4831	1.2096	0.8865	1.7901	2.6399	1.9845	Deaths
2046	1.6699	2.0985	1.4742	1.2047	0.8551	1.7900	2.6926	1.9950	Deaths
2047	1.6696	2.1017	1.4658	1.2002	0.8124	1.7899	2.7465	2.0051	Deaths
2048	1.6694	2.1046	1.4578	1.1963	0.7718	1.7898	2.8014	2.0137	Deaths
2049	1.6692	2.1072	1.4502	1.1927	0.7332	1.7898	2.8575	2.0199	Deaths
2050	1.6690	2.1095	1.4430	1.1894	0.6965	1.7897	2.9146	2.0228	Deaths
2022	113.2473	112.3187	106.4295	117.9009	109.1304	112.8567	110.9605	112.7194	Incidence
2023	113.6248	112.3510	105.2728	123.2349	109.6583	113.3235	109.5408	112.8191	Incidence
2024	114.6692	112.3802	104.1738	128.2797	110.1166	113.7056	108.0451	113.5207	Incidence
2025	116.0009	112.4067	103.1298	133.0313	108.7619	114.0185	106.4858	113.8891	Incidence
2026	117.0117	112.4306	102.1381	137.4900	108.5010	114.2747	104.8718	114.2026	Incidence
2027	117.8467	112.4523	101.1959	141.6596	106.2405	114.4844	103.2090	114.4630	Incidence
2028	118.5355	112.4719	100.3008	145.5468	102.0731	114.6562	101.5018	114.6119	Incidence
2029	119.1029	112.4897	99.4505	149.1606	98.9706	114.7968	99.7531	114.6897	Incidence
2030	119.5697	112.5057	98.6426	152.5117	96.8385	114.9119	97.9650	114.8043	Incidence
2031	119.9535	112.5202	97.8752	155.6121	96.3180	115.0061	96.1390	115.1067	Incidence
2032	120.2687	112.5334	97.1462	158.4744	96.8245	115.0833	94.2761	115.6133	Incidence
2033	120.5275	112.5453	96.4536	161.1120	98.0671	115.1464	92.3906	116.1439	Incidence
2034	120.7399	112.5560	95.7956	163.5383	97.7575	115.1982	90.5428	116.6492	Incidence
2035	120.9141	112.5657	95.1705	165.7667	98.1325	115.2405	88.7320	117.0912	Incidence
2036	121.0570	112.5746	94.5767	167.8106	98.5025	115.2752	86.9573	117.5766	Incidence
2037	121.1740	112.5825	94.0126	169.6828	97.1051	115.3036	85.2182	118.0108	Incidence
2038	121.2700	112.5897	93.4767	171.3957	96.8463	115.3268	83.5138	118.2638	Incidence
2039	121.3486	112.5963	92.9675	172.9613	94.6063	115.3458	81.8435	118.3420	Incidence
2040	121.4131	112.6022	92.4839	174.3908	90.4609	115.3614	80.2067	118.3032	Incidence
2041	121.4658	112.6075	92.0244	175.6950	87.3725	115.3742	78.6025	118.2540	Incidence
2042	121.5091	112.6123	91.5879	176.8839	85.2328	115.3846	77.0305	118.3327	Incidence
2043	121.5445	112.6167	91.1732	177.9669	84.6788	115.3932	75.4899	118.6009	Incidence
2044	121.5734	112.6207	90.7792	178.9528	85.1281	115.4002	73.9801	119.0935	Incidence
2045	121.5972	112.6243	90.4050	179.8499	86.3003	115.4059	72.5005	119.6384	Incidence
2046	121.6166	112.6275	90.0494	180.6657	85.9188	115.4106	71.0505	120.2204	Incidence
2047	121.6326	112.6304	89.7117	181.4072	86.2403	115.4144	69.6294	120.7744	Incidence
2048	121.6456	112.6331	89.3908	182.0809	86.5854	115.4176	68.2369	121.2568	Incidence
2049	121.6563	112.6355	89.0860	182.6927	85.1934	115.4201	66.8721	121.6110	Incidence
2050	121.6650	112.6377	88.7964	183.2482	84.9704	115.4223	65.5347	121.7865	Incidence
2022	276.7072	280.9383	272.1280	294.6414	274.2944	281.2136	276.7472	281.6927	Prevalence
2023	278.4447	281.2675	270.5116	307.9715	271.7169	281.7071	273.1043	281.9418	Prevalence
2024	281.5014	281.5654	268.9760	320.5788	268.0569	282.1111	269.6494	283.7948	Prevalence
2025	284.4743	281.8350	267.5172	332.4534	264.1179	282.4419	266.3594	284.7372	Prevalence
2026	285.5137	282.0789	266.1313	343.5959	256.7392	282.7127	263.2184	285.5163	Prevalence
2027	286.3680	282.2996	264.8147	354.0159	257.1599	282.9345	260.2150	286.1393	Prevalence
2028	287.0696	282.4993	263.5640	363.7303	251.1322	283.1160	257.3414	286.4691	Prevalence
2029	287.6454	282.6799	262.3758	372.7615	249.2451	283.2646	254.5920	286.6179	Prevalence
2030	288.1179	282.8434	261.2470	381.1361	249.1194	283.3863	251.9630	286.8674	Prevalence
2031	288.5054	282.9913	260.1746	388.8840	250.3823	283.4860	249.4517	287.6037	Prevalence

Table 18 (continued)

Year	Prophet	ARIMA	TBATS	ElasticNet	ETS	VAR	HoltWinters	Theta	Metric
2032	288.8230	283.1252	259.1558	396.0372	247.6463	283.5675	247.0562	288.8718	Prevalence
2033	289.0834	283.2463	258.1880	402.6286	250.4487	283.6343	244.7752	290.2187	Prevalence
2034	289.2968	283.3559	257.2686	408.6921	248.1451	283.6890	242.6077	291.5135	Prevalence
2035	289.4717	283.4551	256.3952	414.2612	245.8902	283.7338	240.5531	292.6499	Prevalence
2036	289.6149	283.5448	255.5654	419.3690	242.6948	283.7704	238.6109	293.8838	Prevalence
2037	289.7323	283.6260	254.7771	424.0476	239.3262	283.8004	236.7809	294.9712	Prevalence
2038	289.8284	283.6994	254.0282	428.3283	232.5791	283.8250	235.0627	295.5840	Prevalence
2039	289.9071	283.7659	253.3168	432.2408	233.6890	283.8451	233.4563	295.7425	Prevalence
2040	289.9716	283.8260	252.6409	435.8132	228.3234	283.8616	231.9615	295.6001	Prevalence
2041	290.0244	283.8805	251.9989	439.0724	227.0675	283.8751	230.5783	295.4346	Prevalence
2042	290.0676	283.9297	251.3889	442.0435	227.5125	283.8861	229.3065	295.6037	Prevalence
2043	290.1030	283.9743	250.8094	444.7501	229.2793	283.8951	228.1463	296.2696	Prevalence
2044	290.1320	284.0146	250.2589	447.2140	226.9804	283.9025	227.0975	297.5222	Prevalence
2045	290.1557	284.0511	249.7360	449.4559	230.1971	283.9086	226.1601	298.9273	Prevalence
2046	290.1751	284.0841	249.2392	451.4946	228.2928	283.9136	225.3341	300.4381	Prevalence
2047	290.1911	284.1139	248.7672	453.3476	226.4590	283.9176	224.6195	301.8788	Prevalence
2048	290.2041	284.1410	248.3188	455.0312	223.7214	283.9209	224.0162	303.1280	Prevalence
2049	290.2147	284.1654	247.8928	456.5603	220.8515	283.9237	223.5244	304.0345	Prevalence
2050	290.2235	284.1875	247.4882	457.9484	214.6288	283.9259	223.1440	304.4688	Prevalence

life-or-death outcomes, with patients in low-resource settings facing higher risks of complications such as incarceration, strangulation, and bowel obstruction due to delayed surgical care. Our findings are consistent with previous studies [24], emphasizing that the success of public health interventions for hernias is inexorably tied to broader socioeconomic development and healthcare system strengthening.

Gender disparities were particularly pronounced in our analysis, with male age-standardized incidence rates in 2021 (203.41/100,000) approximately 7.3 times higher than female rates (27.94/100,000). This substantial differential stems from both biological and social factors. Anatomically, males have a larger potential weak point in the inguinal canal where the spermatic cord passes, creating an inherent vulnerability [25, 26]. Occupationally, men are more frequently engaged in heavy manual labor that increases intra-abdominal pressure [27]. Additionally, behavioral factors including delayed healthcare-seeking patterns among men may contribute to these differences. The persistent gender gap, despite overall declining rates for both sexes, suggests that prevention strategies should consider gender-specific approaches, including targeted occupational safety measures for male-dominated industries and improved health education to encourage earlier medical consultation.

A novel contribution of our study is the analysis of correlations between health workforce distribution and hernia burden. We found significant negative associations between pharmaceutical personnel density and hernia DALYs, with correlation coefficients strengthening from 1990 ($r = -0.39$, $p < 0.001$) to 2019 ($r = -0.57$, $p < 0.001$). Similar trends were observed for dentistry personnel (DALYs: $r = -0.26$ in 1990 to $r = -0.47$ in 2019, $p < 0.001$). While these correlations persisted after controlling for socioeconomic factors, we acknowledge that these associations should not be interpreted as directly causal. Rather, they likely represent surrogate indicators of broader health system strength and capacity. These workforce metrics were selected based on global data standardization and availability, though future studies incorporating surgical and primary care provider densities would further enrich this analysis. Nevertheless, the observed relationships suggest that comprehensive healthcare infrastructure—beyond just surgical specialists—may be associated with improved hernia outcomes. The strengthening correlation over time may reflect the growing importance of robust healthcare infrastructure in addressing complex conditions like hernias, particularly in aging populations with multiple comorbidities. We hypothesize that pharmaceutical personnel might indirectly influence hernia outcomes through appropriate medication management for chronic conditions that exacerbate hernias (like COPD or constipation), while dental health professionals could potentially serve as entry points to healthcare systems in some communities, possibly facilitating earlier diagnosis and referral. However, these mechanisms remain speculative and require

Table 19 Absolute number projections for inguinal, femoral and abdominal hernia using eight time series machine learning models: incidence, prevalence, mortality, and DALYs (Both sexes combined, age 45 + years)

Year	Prophet	ARIMA	TBATS	ElasticNet	ETS	VAR	HoltWinters	Theta	Metric
2022	1,151,627	1,218,787	1,220,057	1,264,293	1,197,064	1,208,732	1,216,210	1,208,731	DALYs
2023	1,181,533	1,233,564	1,234,029	1,321,492	1,242,359	1,212,534	1,232,535	1,209,800	DALYs
2024	1,211,456	1,246,935	1,247,303	1,375,590	1,242,025	1,215,647	1,252,098	1,215,348	DALYs
2025	1,234,136	1,259,034	1,259,913	1,426,543	1,251,098	1,218,196	1,274,225	1,218,873	DALYs
2026	1,242,274	1,269,981	1,271,893	1,474,355	1,209,101	1,220,282	1,298,442	1,222,321	DALYs
2027	1,248,983	1,279,887	1,283,273	1,519,067	1,257,177	1,221,990	1,324,411	1,225,658	DALYs
2028	1,254,506	1,288,849	1,294,085	1,560,751	1,278,730	1,223,389	1,350,899	1,228,096	DALYs
2029	1,259,049	1,296,959	1,304,356	1,599,503	1,284,599	1,224,534	1,377,917	1,229,834	DALYs
2030	1,262,782	1,304,298	1,314,113	1,635,438	1,301,668	1,225,472	1,405,476	1,231,794	DALYs
2031	1,265,848	1,310,937	1,323,383	1,668,684	1,319,578	1,226,239	1,433,585	1,235,418	DALYs
2032	1,268,365	1,316,945	1,332,189	1,699,378	1,339,814	1,226,868	1,462,257	1,240,809	DALYs
2033	1,270,430	1,322,382	1,340,555	1,727,662	1,359,058	1,227,382	1,491,502	1,246,084	DALYs
2034	1,272,123	1,327,300	1,348,502	1,753,680	1,341,328	1,227,804	1,521,332	1,250,872	DALYs
2035	1,273,512	1,331,751	1,356,052	1,777,576	1,386,156	1,228,148	1,551,759	1,254,979	DALYs
2036	1,274,650	1,335,779	1,363,225	1,799,494	1,385,212	1,228,431	1,582,794	1,259,770	DALYs
2037	1,275,582	1,339,423	1,370,039	1,819,570	1,393,577	1,228,662	1,614,450	1,264,385	DALYs
2038	1,276,346	1,342,720	1,376,512	1,837,938	1,350,530	1,228,851	1,646,739	1,267,479	DALYs
2039	1,276,972	1,345,703	1,382,662	1,854,726	1,397,753	1,229,006	1,679,673	1,269,049	DALYs
2040	1,277,485	1,348,403	1,388,504	1,870,055	1,418,419	1,229,133	1,713,267	1,269,537	DALYs
2041	1,277,905	1,350,846	1,394,054	1,884,040	1,423,577	1,229,237	1,747,532	1,269,850	DALYs
2042	1,278,249	1,353,056	1,399,327	1,896,789	1,440,303	1,229,322	1,782,483	1,271,239	DALYs
2043	1,278,531	1,355,056	1,404,336	1,908,403	1,458,251	1,229,392	1,818,132	1,274,201	DALYs
2044	1,278,761	1,356,865	1,409,094	1,918,976	1,478,859	1,229,449	1,854,495	1,279,058	DALYs
2045	1,278,950	1,358,503	1,413,615	1,928,595	1,498,667	1,229,495	1,891,585	1,284,038	DALYs
2046	1,279,105	1,359,984	1,417,909	1,937,343	1,481,448	1,229,534	1,929,417	1,289,167	DALYs
2047	1,279,232	1,361,325	1,421,989	1,945,295	1,526,735	1,229,565	1,968,005	1,293,995	DALYs
2048	1,279,335	1,362,538	1,425,865	1,952,519	1,525,868	1,229,591	2,007,365	1,298,306	DALYs
2049	1,279,420	1,363,635	1,429,547	1,959,080	1,533,980	1,229,612	2,047,512	1,301,677	DALYs
2050	1,279,490	1,364,628	1,433,045	1,965,036	1,490,298	1,229,629	2,088,463	1,303,645	DALYs
2022	40,150	42,195	43,125	43,926	43,511	41,877	42,698	41,995	Deaths
2023	40,952	42,558	43,584	45,913	44,505	41,912	43,552	42,032	Deaths
2024	41,656	42,887	44,021	47,792	43,704	41,940	44,423	42,220	Deaths
2025	42,107	43,184	44,435	49,563	44,527	41,964	45,311	42,341	Deaths
2026	42,180	43,453	44,829	51,224	44,256	41,983	46,218	42,461	Deaths
2027	42,239	43,697	45,204	52,777	44,776	41,999	47,142	42,579	Deaths
2028	42,289	43,917	45,559	54,225	45,175	42,012	48,085	42,666	Deaths
2029	42,329	44,116	45,897	55,572	45,232	42,022	49,047	42,728	Deaths
2030	42,362	44,296	46,218	56,820	46,280	42,031	50,027	42,798	Deaths
2031	42,389	44,460	46,523	57,975	47,013	42,038	51,028	42,925	Deaths
2032	42,411	44,607	46,813	59,042	47,683	42,044	52,049	43,112	Deaths
2033	42,429	44,741	47,088	60,025	48,120	42,049	53,090	43,295	Deaths
2034	42,444	44,862	47,349	60,928	48,738	42,052	54,151	43,459	Deaths
2035	42,456	44,971	47,597	61,759	49,711	42,056	55,234	43,600	Deaths
2036	42,466	45,070	47,833	62,520	48,885	42,058	56,339	43,766	Deaths
2037	42,474	45,160	48,057	63,218	49,685	42,060	57,466	43,926	Deaths
2038	42,481	45,241	48,270	63,856	49,380	42,062	58,615	44,034	Deaths
2039	42,486	45,314	48,473	64,439	49,866	42,064	59,787	44,091	Deaths
2040	42,491	45,380	48,665	64,972	50,232	42,065	60,983	44,110	Deaths

Table 19 (continued)

Year	Prophet	ARIMA	TBATS	ElasticNet	ETS	VAR	HoltWinters	Theta	Metric
2041	42,495	45,440	48,847	65,458	50,263	42,066	62,203	44,123	Deaths
2042	42,498	45,495	49,021	65,901	51,299	42,066	63,447	44,173	Deaths
2043	42,500	45,544	49,185	66,304	52,034	42,067	64,716	44,276	Deaths
2044	42,502	45,588	49,342	66,671	52,717	42,068	66,010	44,444	Deaths
2045	42,504	45,629	49,491	67,006	53,175	42,068	67,330	44,615	Deaths
2046	42,505	45,665	49,632	67,310	53,813	42,068	68,677	44,790	Deaths
2047	42,506	45,698	49,766	67,586	54,803	42,069	70,051	44,955	Deaths
2048	42,507	45,728	49,893	67,837	53,978	42,069	71,452	45,102	Deaths
2049	42,508	45,755	50,015	68,065	54,769	42,069	72,881	45,218	Deaths
2050	42,508	45,779	50,130	68,272	54,443	42,069	74,338	45,287	Deaths
2022	2,656,663	2,764,122	2,632,520	2,844,592	2,686,361	2,739,747	2,709,843	2,719,580	Incidence
2023	2,739,387	2,819,404	2,660,874	2,973,287	2,751,302	2,764,811	2,722,552	2,721,985	Incidence
2024	2,831,206	2,869,425	2,687,810	3,095,003	2,785,107	2,785,331	2,743,750	2,733,683	Incidence
2025	2,915,773	2,914,686	2,713,399	3,209,644	2,812,471	2,802,131	2,770,980	2,741,446	Incidence
2026	2,973,411	2,955,640	2,737,709	3,317,219	2,864,681	2,815,886	2,802,520	2,749,237	Incidence
2027	3,021,573	2,992,697	2,760,804	3,417,819	2,860,296	2,827,147	2,837,166	2,756,962	Incidence
2028	3,061,670	3,026,227	2,782,744	3,511,606	2,885,781	2,836,368	2,874,074	2,762,781	Incidence
2029	3,094,953	3,056,567	2,803,586	3,598,796	2,882,352	2,843,917	2,912,654	2,767,050	Incidence
2030	3,122,511	3,084,019	2,823,387	3,679,648	2,898,650	2,850,097	2,952,494	2,771,752	Incidence
2031	3,145,283	3,108,859	2,842,198	3,754,450	2,938,722	2,855,157	2,993,303	2,780,056	Incidence
2032	3,164,068	3,131,335	2,860,068	3,823,509	3,010,403	2,859,300	3,034,880	2,792,169	Incidence
2033	3,179,545	3,151,672	2,877,044	3,887,146	3,097,945	2,862,692	3,077,083	2,803,873	Incidence
2034	3,192,280	3,170,074	2,893,172	3,945,685	3,131,420	2,865,469	3,119,812	2,814,394	Incidence
2035	3,202,750	3,186,724	2,908,493	3,999,452	3,195,605	2,867,743	3,162,998	2,823,385	Incidence
2036	3,211,352	3,201,790	2,923,049	4,048,764	3,228,387	2,869,604	3,206,592	2,833,999	Incidence
2037	3,218,414	3,215,423	2,936,876	4,093,934	3,254,050	2,871,128	3,250,561	2,844,368	Incidence
2038	3,224,209	3,227,758	2,950,012	4,135,262	3,303,951	2,872,376	3,294,881	2,851,479	Incidence
2039	3,228,963	3,238,919	2,962,492	4,173,034	3,296,702	2,873,398	3,339,534	2,855,302	Incidence
2040	3,232,861	3,249,018	2,974,347	4,207,524	3,319,545	2,874,234	3,384,510	2,856,760	Incidence
2041	3,236,056	3,258,156	2,985,610	4,238,990	3,314,054	2,874,919	3,429,799	2,857,797	Incidence
2042	3,238,675	3,266,425	2,996,309	4,267,674	3,329,387	2,875,480	3,475,397	2,861,140	Incidence
2043	3,240,821	3,273,906	3,006,474	4,293,804	3,369,725	2,875,939	3,521,300	2,867,839	Incidence
2044	3,242,579	3,280,676	3,016,130	4,317,592	3,442,750	2,876,315	3,567,504	2,878,596	Incidence
2045	3,244,019	3,286,801	3,025,303	4,339,236	3,532,256	2,876,622	3,614,007	2,889,458	Incidence
2046	3,245,199	3,292,344	3,034,018	4,358,919	3,567,618	2,876,874	3,660,809	2,900,556	Incidence
2047	3,246,165	3,297,359	3,042,297	4,376,809	3,633,207	2,877,081	3,707,908	2,910,977	Incidence
2048	3,246,957	3,301,897	3,050,162	4,393,063	3,666,388	2,877,249	3,755,304	2,920,334	Incidence
2049	3,247,605	3,306,003	3,057,634	4,407,825	3,691,334	2,877,388	3,802,996	2,927,750	Incidence
2050	3,248,136	3,309,718	3,064,732	4,421,227	3,739,596	2,877,501	3,850,983	2,932,212	Incidence
2022	6,610,327	6,876,557	6,680,123	7,085,613	6,741,722	6,804,692	6,736,744	6,774,219	Prevalence
2023	6,784,239	7,005,602	6,772,678	7,406,179	6,911,556	6,850,941	6,760,294	6,780,209	Prevalence
2024	6,964,985	7,122,366	6,860,605	7,709,362	7,009,192	6,888,807	6,809,142	6,810,640	Prevalence
2025	7,123,134	7,228,019	6,944,136	7,994,924	7,047,373	6,919,809	6,876,488	6,830,255	Prevalence
2026	7,226,499	7,323,618	7,023,491	8,262,882	7,046,253	6,945,191	6,957,573	6,849,605	Prevalence
2027	7,312,406	7,410,119	7,098,877	8,513,467	7,122,938	6,965,972	7,049,066	6,868,492	Prevalence
2028	7,383,611	7,488,388	7,170,495	8,747,081	7,215,926	6,982,986	7,148,635	6,882,437	Prevalence
2029	7,442,501	7,559,209	7,238,531	8,964,265	7,295,182	6,996,916	7,254,648	6,892,480	Prevalence
2030	7,491,117	7,623,291	7,303,166	9,165,660	7,394,821	7,008,321	7,365,961	6,903,712	Prevalence
2031	7,531,191	7,681,275	7,364,569	9,351,984	7,513,873	7,017,659	7,481,775	6,924,148	Prevalence

Table 19 (continued)

Year	Prophet	ARIMA	TBATS	ElasticNet	ETS	VAR	HoltWinters	Theta	Metric
2032	7,564,183	7,733,740	7,422,902	9,524,004	7,684,118	7,025,304	7,601,530	6,954,349	Prevalence
2033	7,591,318	7,781,213	7,478,318	9,682,517	7,879,231	7,031,563	7,724,834	6,983,774	Prevalence
2034	7,613,618	7,824,168	7,530,963	9,828,333	7,923,568	7,036,687	7,851,413	7,010,393	Prevalence
2035	7,631,931	7,863,036	7,580,976	9,962,260	8,091,784	7,040,883	7,981,074	7,033,201	Prevalence
2036	7,646,962	7,898,204	7,628,489	10,085,093	8,186,998	7,044,318	8,113,684	7,059,910	Prevalence
2037	7,659,294	7,930,027	7,673,625	10,197,608	8,220,717	7,047,130	8,249,148	7,085,764	Prevalence
2038	7,669,407	7,958,820	7,716,505	10,300,551	8,213,161	7,049,433	8,387,400	7,103,229	Prevalence
2039	7,677,699	7,984,874	7,757,241	10,394,638	8,282,643	7,051,318	8,528,395	7,112,273	Prevalence
2040	7,684,495	8,008,448	7,795,940	10,480,549	8,368,781	7,052,862	8,672,099	7,115,314	Prevalence
2041	7,690,064	8,029,779	7,832,705	10,558,927	8,442,862	7,054,125	8,818,490	7,117,349	Prevalence
2042	7,694,627	8,049,080	7,867,631	10,630,377	8,540,127	7,055,160	8,967,553	7,125,319	Prevalence
2043	7,698,366	8,066,544	7,900,810	10,695,464	8,659,963	7,056,007	9,119,277	7,141,948	Prevalence
2044	7,701,428	8,082,347	7,932,331	10,754,719	8,833,784	7,056,701	9,273,653	7,169,023	Prevalence
2045	7,703,936	8,096,645	7,962,276	10,808,632	9,034,090	7,057,269	9,430,676	7,196,642	Prevalence
2046	7,705,990	8,109,583	7,990,723	10,857,659	9,083,407	7,057,733	9,590,343	7,225,013	Prevalence
2047	7,707,673	8,121,290	8,017,748	10,902,221	9,255,397	7,058,114	9,752,650	7,251,698	Prevalence
2048	7,709,051	8,131,882	8,043,422	10,942,709	9,351,719	7,058,426	9,917,596	7,275,570	Prevalence
2049	7,710,179	8,141,467	8,067,812	10,979,479	9,383,505	7,058,681	10,085,180	7,294,321	Prevalence
2050	7,711,103	8,150,140	8,090,983	11,012,862	9,371,406	7,058,890	10,255,401	7,305,379	Prevalence

further research to establish causality. More likely, these workforce metrics may primarily serve as indicators of overall healthcare system development and resource availability, which directly impacts access to timely surgical intervention and quality care. Countries with high hernia burden consistently demonstrated lower health workforce density. For example, Guatemala, Paraguay, and Indonesia—which ranked among the highest in age-standardized hernia DALYs—showed substantially lower pharmaceutical and dental personnel densities compared to countries with lower hernia burden. This pattern suggests that investments in developing a diverse healthcare workforce may yield benefits beyond their immediate specialties, creating positive externalities for conditions like hernias that require coordinated care across multiple health domains.

The observed negative associations between healthcare workforce density and hernia burden may largely reflect confounding by broader socioeconomic and healthcare system factors, despite our statistical adjustments. Countries with higher densities of healthcare personnel typically possess superior healthcare infrastructure, better public health education, improved access to preventive services, and more robust surgical capacity—all of which likely contribute more directly to reduced hernia complications than the specific presence of pharmaceutical or dental professionals. Furthermore, reverse causality cannot be ruled out, as regions with lower disease burdens may attract or retain more healthcare workers. Future research employing longitudinal designs, mediator analyses, and natural experiments is needed to disentangle these complex relationships and establish whether specific aspects of workforce composition truly impact hernia outcomes independent of general healthcare system quality. Our findings should therefore be viewed as hypothesis-generating rather than definitive evidence of a protective effect from specific healthcare personnel categories.

The multi-model prediction approach used in this study provides reliable projections of future hernia burdens through 2050. By employing eight different machine learning (Figs. 17 and 18) algorithms (Prophet, ARIMA, TBATS, ElasticNet, ETS, VAR, HoltWinters, and Theta), we capture complex temporal patterns and account for modeling uncertainties that single-model approaches might miss. Despite inevitable uncertainties in long-term projections, the consistency across models strengthens confidence in the overall trend direction. Our projections indicate that by 2050, age-standardized incidence rates will increase slightly from 112.32/100,000 in 2022 to 112.64/100,000, with absolute new cases increasing by 19.70%. More concerning, age-standardized mortality rates are projected to increase from 1.84/100,000 to 2.11/100,000, with deaths increasing by 8.50%. These trends underscore the growing strain on global healthcare systems, particularly in regions with limited surgical capacity [11]. The projected increases in both incidence and mortality suggest that demographic forces

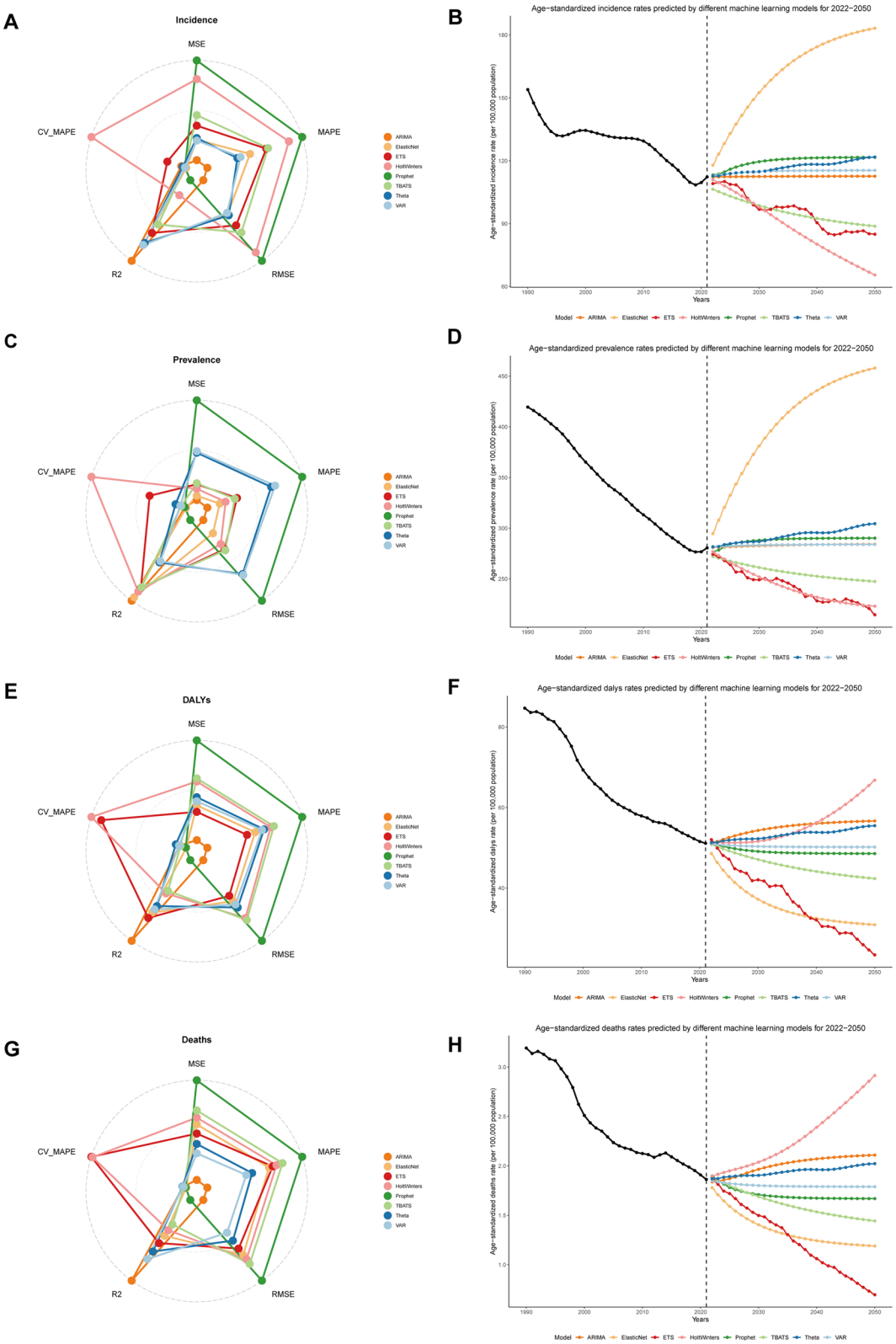

Fig. 17 Machine learning time series predictions of age-standardized rates for inguinal, femoral, and abdominal hernia (aged 45 + years, both sexes combined), 2022–2050. **A**, **C**, **E**, **G** Radar charts of model performance metrics for age-standardized rate predictions. **B**, **D**, **F**, **H** Predicted trends in age-standardized rates, 2022–2050. **A**, **B** Incidence. **C**, **D** Prevalence. **E**, **F** DALYs. **G**, **H** Mortality

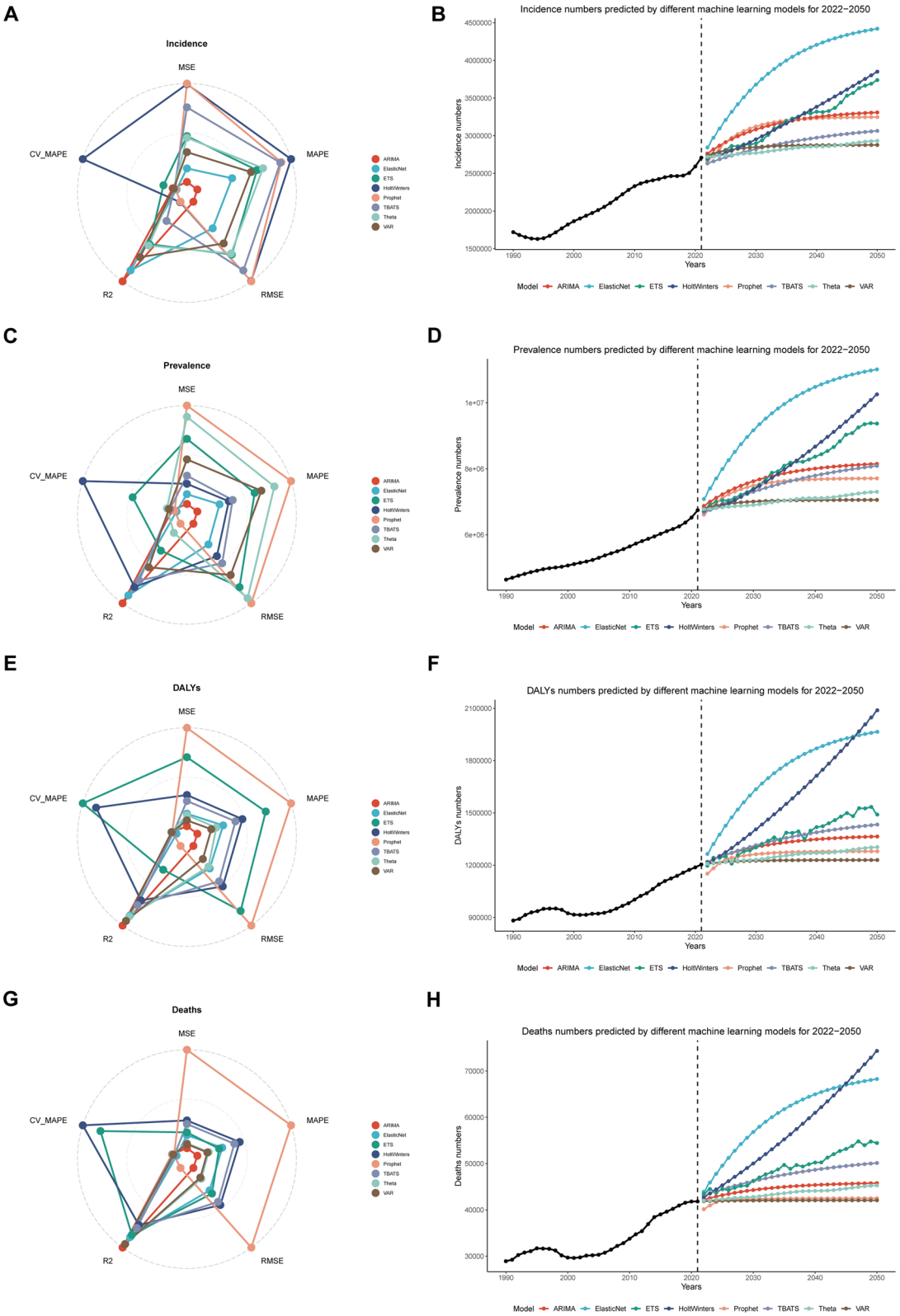

Fig. 18 Machine learning time series predictions of absolute numbers for inguinal, femoral, and abdominal hernia (aged 45 + years, both sexes combined), 2022–2050. **A**, **C**, **E**, **G** Radar charts of model performance metrics for absolute number predictions. **B**, **D**, **F**, **H** Predicted trends in absolute numbers, 2022–2050. **A**, **B** Incidence. **C**, **D** Prevalence. **E**, **F** DALYs. **G**, **H** Mortality

may outpace improvements in healthcare delivery without targeted interventions. These findings emphasize the urgent need for comprehensive approaches, including enhancing healthcare infrastructure in low-resource settings [28], scaling up surgical training programs [29], improving the distribution of healthcare workers across regions, and promoting early detection and management strategies [30]. Particularly in regions facing health workforce shortages, innovative service delivery models—such as task-shifting for routine hernia screening to non-specialist providers and telemedicine consultations for post-operative follow-up—may help extend the reach of limited specialist resources.

Strengths and limitations

The study's strengths lie in its comprehensive global coverage, long-term trend analysis, sophisticated multimodel forecasting approach, and novel examination of health workforce correlations. However, several limitations warrant consideration.

Data quality and completeness may vary across regions, potentially introducing bias, particularly in low-resource settings with less robust health information systems. The GBD methodology attempts to adjust for these variations, but residual bias cannot be entirely ruled out. Additionally, while the SDI provides a useful composite measure of development, it may obscure important within-country variations in socioeconomic status and healthcare access that influence hernia outcomes.

Our analysis lacks sub-national level detail that would capture important regional variations within countries. This is particularly limiting for large, heterogeneous nations such as the United States, China, and India, where significant regional disparities in healthcare access, socioeconomic conditions, and hernia management likely exist. The national averages presented may therefore mask critical geographic hotspots of high hernia burden or inadequate surgical capacity. Additionally, the focus on the population aged 45 years and older, while providing valuable insights for this high-risk group, limits understanding of the complete epidemiological picture. Hernia patterns, risk factors, and trends may differ substantially in younger populations, potentially driven by different occupational exposures, congenital factors, or other age-specific determinants. Consequently, our findings and policy implications should be interpreted as applicable specifically to middle-aged and older adults rather than representing the entire global hernia burden. These scope limitations suggest that while our results are valuable for international and national-level policy development, they may require careful adaptation for sub-national implementation or for addressing hernia burden across the complete age spectrum.

Our projections, while methodologically robust, cannot fully account for potential future developments in hernia prevention, diagnosis, and treatment. Advances in minimally invasive surgical techniques, mesh materials, or even pharmacological approaches to strengthen connective tissue could alter future trajectories. Furthermore, these projections cannot account for possible future advances in healthcare delivery and surgical technology that could alter disease burden patterns.

The correlations identified between health workforce density and hernia outcomes represent ecological associations that should not be interpreted as definitively causal. Our cross-sectional analysis of health workforce correlations cannot fully elucidate the mechanisms through which healthcare personnel influence hernia outcomes.

Finally, our analysis does not fully address modifiable risk factors beyond those captured in broad socioeconomic and demographic variables, nor does it comprehensively address indirect effects such as economic costs and quality of life impacts. Future studies incorporating data on specific lifestyle factors (such as smoking, obesity, and occupational exposures), comorbidity patterns, and healthcare-seeking behaviors could further refine our understanding of hernia determinants and identify targeted intervention opportunities.

Addressing these limitations in future research could improve the precision of epidemiological understanding and enhance the utility of targeted interventions for reducing the global burden of hernias.

Future research directions

Several promising research directions emerge from our findings. First, studies examining the mechanisms through which different types of healthcare workers influence hernia outcomes could inform more effective workforce planning and task allocation. Second, implementation research evaluating different service delivery models for hernia care, particularly in resource-constrained environments, could identify cost-effective approaches to expanding surgical capacity. Third, investigating the relationship between specific modifiable risk factors and hernia incidence in older adults could inform preventive interventions. Additionally, more granular analyses at sub-national levels would help identify regional hotspots of hernia burden and healthcare access barriers within countries. Longitudinal studies tracking individual-level risk factors, healthcare utilization patterns, and outcomes would

complement our population-level findings and provide deeper insights into causal mechanisms.

Conclusion

This study highlights the dual challenges of rising absolute hernia burden and persistent healthcare inequalities across socioeconomic strata, geographic regions, and gender. While progress has been made in reducing age-standardized rates, demographic forces continue to drive increasing absolute numbers of hernia cases, deaths, and disability. Our novel findings regarding health workforce correlations suggest that strengthening broader healthcare systems—not just surgical capacity—may yield important benefits for hernia outcomes. Addressing the growing hernia burden in aging populations will require multipronged approaches: strengthening preventive measures, optimizing surgical and non-surgical management strategies, addressing healthcare workforce distribution disparities, and reducing socioeconomic barriers to timely care. These efforts, informed by our detailed analysis of trends, disparities, and projections, are critical to reducing the global burden of hernias and improving outcomes for affected populations worldwide.

Acknowledgements
We would like to express our sincere gratitude to the Global Burden of Disease (GBD) study for providing downloadable data on Inguinal, Femoral, and Abdominal Hernia, which has been invaluable for conducting this research.

Authors' contributions
Conceptualization, F.D., Y.C.; Data management, F.D., T.Z.; Methodology, F.D., H.L. and R.S.; Software, F.D., Y.C.; Supervision, Y.D.; Writing—original draft, F.D., Y.C.; Writing—criticism and editing, F.D., Y.C.; Visualization, F.D., Y.C. All authors have read and agreed to the published version of the manuscript.

Funding
Not applicable.

Data availability
The data used for the analyses in the study are publicly available at https://ghdx.healthdata.org/gbd-2021.

Declarations

Ethics approval and consent to participate
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Department of Gastrointestinal Surgery, The First Affiliated Hospital of Kunming Medical University, Yun Nan 650032, China. [2]Department of Hepatobiliary Surgery, The Affiliated Hospital of Qinghai University, Qing Hai 810006, China.

Received: 4 February 2025 Accepted: 18 April 2025
Published online: 25 April 2025

References

1. Yang G, Tung KLM, Tumtavitikul S, Li MKW. A new groin hernia classification with clinical relevance. Hernia. 2024;28:1169–79.
2. Fitzgibbons RJ, Forse RA. Groin Hernias in Adults. N Engl J Med. 2015;372:756–63.
3. Brown LR, et al. Demographics, diagnostics, treatment, and outcomes of patients presenting with acute groin hernia: 15-year multicentre retrospective cohort study. BJS Open. 2023;7:zrad091.
4. Messias BA, et al. Lichtenstein technique for inguinal hernia repair: ten recommendations to optimize surgical outcomes. Hernia. 2024;28:1467–76.
5. Pelly T, Hwang R, Nirmalan P & Perkins Z. Inguinal and femoral hernias. BMJ. 2024;e079531. https://doi.org/10.1136/bmj-2024-079531.
6. Montgomery J, Dimick JB, Telem DA. Management of Groin Hernias in Adults—2018. JAMA. 2018;320:1029.
7. Lorenz WR, et al. Open versus laparoscopic versus robotic inguinal hernia repair: A propensity-matched outcome analysis. Surgery. 2024;S0039–6060(24):00832–8. https://doi.org/10.1016/j.surg.2024.08.054.
8. Liu X, Ma B, Ma Q, Wang F, Shen Y. Trends and cross-country inequalities in the global burden of inguinal, femoral, and abdominal hernia from 1990 to 2021, with projections from 2022 to 2035: a cross-sectional study. Hernia. 2025;29:91.
9. Wang F, Ma B, Ma Q, Liu X. Global, regional, and national burden of inguinal, femoral, and abdominal hernias: a systematic analysis of prevalence, incidence, deaths, and DALYs with projections to 2030. Int J Surg. 2024;110:1951–67.
10. Ma Q, et al. The global, regional, and national burden and its trends of inguinal, femoral, and abdominal hernia from 1990 to 2019: findings from the 2019 Global Burden of Disease Study – a cross-sectional study. Int J Surg. 2023;109:333–42.
11. Yelorda K, Rose L, Bundorf MK, Muhammad HA, Morris AM. Association Between High-Deductible Health Plans and Hernia Acuity. JAMA Surg. 2022;157:321–6.
12. Sakowitz S, et al. Association of socioeconomic vulnerability with clinical and financial outcomes following emergent hernia repair. The American Journal of Surgery. 2024;235: 115781.
13. Ferrari AJ, et al. Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. The Lancet. 2024;403:2133–61.
14. Naghavi M, et al. Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. The Lancet. 2024;403:2100–32.
15. Schumacher AE, et al. Global age-sex-specific mortality, life expectancy, and population estimates in 204 countries and territories and 811 subnational locations, 1950–2021, and the impact of the COVID-19 pandemic: a comprehensive demographic analysis for the Global Burden of Disease Study 2021. The Lancet. 2024;403:1989–2056.
16. Vollset SE, et al. Burden of disease scenarios for 204 countries and territories, 2022–2050: a forecasting analysis for the Global Burden of Disease Study 2021. The Lancet. 2024;403:2204–56.
17. Vollset SE, 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. The Lancet. 2020;396:1285–306.
18. Santana Valenciano Á, et al. Role of sarcopenia in complex abdominal wall surgery: does it increase postoperative complications and mortality? Hernia. 2024;28:2375–86.
19. Xi S, et al. Comparison of laparoscopic and open inguinal-hernia repair in elderly patients: the experience of two comprehensive medical centers over 10 years. Hernia. 2024;28:1195–203.
20. Lee M, et al. Characteristics and predictors of major occupational injuries in Korean farmers. Inj Prev. 2024;ip–2023–045123. https://doi.org/10.1136/ip-2023-045123.
21. Shabhay AA, et al. Geriatric spontaneous trans-mesenteric herniation leading to death. Case report. Int J Surg Case Rep. 2024;124:110355.
22. Cai X, Song X, Cai X. Strangulated Intestinal Obstruction Secondary to a Typical Obturator Hernia: A Case Report with Literature Review. Int J Med Sci. 2012;9:213–5.

23. Collins CM, Renshaw S, Olson MA, Poulose B, Collins CE. The effects of socioeconomic status on complex ventral hernia repair operative decision-making and outcomes. Surgery. 2024;176:1131–7.
24. Hindawi MD, et al. Global perspectives in acute and emergency general surgery in low and middle-income countries: a WSES project protocol for scoping review on global surgery. World J Emerg Surg. 2025;20:3.
25. Barry HC. 89% of Umbilical Hernias Spontaneously Close by 5 Years of Age. Am Fam Physician. 2024;110:433.
26. Rosen A, Nathan H, Luciansky E, Orda R. The inguinal region: anatomic differences in men and women with reference to hernia formation. Acta Anat (Basel). 1989;136:306–10.
27. Li Y, Li B, Meng F. Evaluating the relationship between standing height, body mass index, body fat percentage with risk of inguinal hernia: a Mendelian randomization study. Sci Rep. 2024;14:26402.
28. Myers HEW, Kunnath N, Ibrahim AM. Social Capital and Surgery Access Among Medicare Beneficiaries. Ann Surg. 2024. https://doi.org/10.1097/SLA.0000000000006482.
29. National Institute for Health and Care Research (NIHR) Global Health Research Unit on Global Surgery et al. Global access to technologies to support safe and effective inguinal hernia surgery: prospective, international cohort study. Bri J Surg. 2024;111:znae164.
30. Boruah P, et al. Patient's Perception of the Role of Gym Activity in Abdominal Wall Herniation in Adults: A Prospective Study. Sports Med Open. 2024;10:88.

Publisher's Note