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Global, regional, and national burden of gout, 1990-2021: an analysis of the global burden of disease study 2021

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SUMMARY

Aim: The global incidence rate of gout has shown a consistent increase, requiring an in-depth study of potential risk factors at the national and regional levels. This study uses data from the 2021 Global Burden of Disease, Injury, and Risk Factors Study to analyze the incidence trend of gout, in order to reveal the global disease burden of gout and provide a basis for optimizing prevention and control strategies for healthcare systems.

Subject and Methods: This study collected data on gout from 1990 to 2021. Conduct decomposition analysis and frontier analysis to determine the changing trends of various indicators and their influencing factors.

Results: According to global data in 2021, the number of incidence cases of gout reached 9,402,000 (95% uncertainty interval [UI]: 7,439,000-11,732,000 cases), and the number of prevalence cases was 56,475,000 (95% UI: 45,162,000-70,288,000 cases). The number of cases of DALYs was 1,748,000 (95% UI: 1,186,000-2,485,000 cases), an increase by 17.15-21.86% since 1990. Further analysis of the data from 1990 to 2021 showed that the estimated annual percentage changes (EAPCs) of the age-standardized incidence rate (ASIR), age-standardized prevalence rate (ASPR), and age-standardized disability-adjusted life-year rate (ASDR) were 0.67 (95% UI: 0.61-0.73), 0.87 (95% UI: 0.8-0.95), and 0.86 (95% UI: 0.78-0.93), respectively. There were more male cases than female cases, and the growth rate was higher in males than in females. However, the rising trend of the global incidence and disability burden of gout in women needs attention.

Conclusion: With social progress, the burden of gout increases, mainly due to population growth and aging. Gout is associated with a high body mass index. Weight loss diets and lifestyle adjustments need to be promoted to reduce health burdens and prevent recurrences.

Keywords: decomposition analysis, frontier analysis, global disease burden, gout

INTRODUCTION

Primarily, gout is caused by elevated uric acid levels and consecutive MSU deposition provoking inflammatory gout flares. If untreated gout might cause irreversible joint damage. When involving the bone cortex, it can lead to gouty fractures and deformities. An early symptom of gout usually manifests as monoarthritis of the lower extremities, which, if recurrent attacks occur, may evolve into chronic arthritis and joint damage [1, 2]. The global prevalence of gout is 0.1%-10%, and it is generally higher in developed countries than in developing countries [3-5].

Due to a wide range of severe complications including hypertension, cardiovascular disease, renal impairment, diabetes, obesity, hyperlipidemia, and metabolic syndrome, gout constitutes a great threat to individual health and imposes a huge socioeconomic burden on global healthcare systems [6-8]. The risk of gout can be increased by drinking, and excessive intake of meat, seafood, and sugared beverages. Moreover, chronic diseases such as hypertension,

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diabetes, hypercholesterolemia, and renal insufficiency have been recognized as high-risk factors for gout attacks [9]. As the global economy rapidly develops and urbanization accelerates, the incidence of gout has been rising in several regions worldwide, making it a public health issue to be addressed [10].

An in-depth and comprehensive assessment of the epidemiological status of gout is of great significance. To ensure the high accuracy and good timeliness of assessment results, the most up-to-date and comprehensive database resources are required. It should be noted that the Global Burden of Disease Study (GBD) 2021 offers the most detailed and comprehensive data on the burden of gout to date, which is an invaluable reference for related research on gout.

Currently, the study data available on the global burden of gout are mostly limited to the year 2019 and earlier [11]. To fully reflect the current situation of gout in real time, an in-depth and detailed analysis of the current epidemiological status of gout worldwide was conducted using the data from the GBD 2021 in this study. In addition, the trend of change in the gout burden over the past three decades under the joint influence of population aging, growth trend of population, and epidemiological drivers was further explored, and the specific position of countries or territories during the development of the gout burden was analyzed to reveal potential and achievable benefits and possible room for improvement in the future. This paper intends to provide more rigorous, scientific, and robust data and theoretical basis for the development of prevention and control strategies for gout worldwide.

METHODS

Overview

The study data were derived from the GBD 2021, an updated version of GBD 2019, guaranteeing the timeliness and accuracy of the data [12] (http://ghdx.healthdata.org/gbd-results-tool). The GBD 2021 extensively collects information from 100,983 independent sources and undergoes a rigorous quality assessment process, fully revealing the global burden of 371 diseases and injuries. This database provides detailed estimates of population size, fertility, incidence, prevalence, death rate, and disability-adjusted life years (DALYs) using a unified and comparable methodological framework in the world's five sociodemographic index (SDI) regions and 204 countries and territories.

Since gout does not directly cause death events (the nonfatal property), this study focused on the assessment of prevalence, incidence, and DALYs. We exhaustively reported the specific values of prevalence, incidence, DALYs, age-standardized incidence rate (ASIR), age-standardized prevalence rate (ASPR), and age-standardized death rate (ASDR) per 100,000 population, as well as 95% uncertainty intervals (UIs). These data were examined separately based on sex, age, location, SDI, and sociodemographic factors, ensuring the comprehensiveness and accuracy of the results.

To obtain consistent and comparable data, ASIR, ASPR, and ASDR were described per 100,000 population as the base unit in this study. The preparation of the study report strictly adhered to the extensive principles and requirements of the EQUATOR Network [13] to ensure its quality and standardization. In addition, the University of Washington Institutional Review Board waived the informed consent requirement for access to the GBD data because the de-identified and aggregated data were used and did not directly disclose private information.

Definition

The GBD 2021 explicitly categorizes gout in the etiology classification system, and cases of gout are identified by the M10 code from the International Classification of Diseases Version 10 (ICD-10). For the gout diagnosis, the GBD strictly follows the criteria for primary gout established by the American College of Rheumatology (ACR). Specifically, the GBD adopts the diagnostic criteria issued by the ACR in 1977, which defined in detail the necessary conditions for the gout diagnosis: the presence of MSU crystals in the joint fluid or an abscess containing MSU crystals, and at least six of the twelve preset gout-related signs or symptoms are strictly verified [14].

SDI

The quintile of the SDI provided in the GBD 2021 was used as the benchmark for analysis in this study. As defined by the GBD, the SDI is a composite indicator for fully assessing the level of socioeconomic development of a specific country or territory. It takes into account several key dimensions, including the educational level of the population under the age of 25, per capita income, and total fertility rate, thereby creating a comprehensive analytical framework for fully examining and evaluating the socioeconomic development status of a country or territory [12]. Based on their SDI, countries and territories are assigned into low, low-middle, middle, high-middle, and high SDI groups.

Statistical analysis

Crude incidence rates (including the prevalence, incidence, and DALYs), as one of the basic indicators for assessing epidemiological trends, are subject to

differences in the age structure of the population, which may produce heterogeneity in the gout burden. To obtain comparable statistical indicators, ASIR, ASPR, and ASDR were used for estimates of the gout burden.

To accurately track the annual change trend of the gout burden, this study presented a detailed profile of gout globally in 1990-2021. The estimated annual percentage changes (EAPCs) for ASIR, ASPR, and age-standardized DALYs were further calculated [EAPC=100 × (exp(β) - 1)] to fully characterize the temporal evolution of the gout-induced disease burden over this period. EAPC, as a widely recognized and commonly used assessment tool, can quantitatively demonstrate the change trends of age-standardized indicators over a specific period, which relies on the model constructed from a regression analysis of the natural logarithm of the incidence rate: ln (rate) = α + β × (calendar year) + ε.

Meanwhile, a linear regression model was utilized to strictly define the 95% confidence interval (CI) of EAPC, thereby ensuring the rigor of the EAPC estimates. As described by the principle of statistics, the age-standardized rate is considered to display an increasing/decreasing trend when both the EAPC value and the lower limit of its 95% CI are higher/lower than 0 [15, 16].

In addition, this study assessed the association of global gout burden (ASIR, ASPR, and ASDR) in 2021 with human development-related indicators using a linear regression model. To further quantify the specific impact of age structure, population growth, and epidemiological changes on the global gout burden, decomposition analyses were conducted [17].

To deeply explore the potential relation of gout burden with sociodemographic development, a frontier analysis model centered on ASIR, ASPR, ASDR, and SDI was established based on the data in 1990-2021. This model intends to provide an in-depth understanding of the potential room for improvement in gout DALY rates in specific countries or territories [18].

By comparative analysis of the data between 1990 and 2021, the changes in each indicator were calculated. The epidemiological data related to gout in 1990-2021 underwent a comprehensive descriptive analysis and visualization by sex, age, location, and year. All graphs were plotted using R4.0.5.

RESULTS

Incidence, prevalence, and DALYs for gout in 1990-2021

Globally, the number of incidence cases of gout had more than doubled from 3,983,000 (95% UI: 3,179,000-4,912,000) in 1990 to 9,402,000 (95% UI: 7,439,000-11,732,000) in 2021. During this period, the ASIR of gout continued to rise from 93.1 cases per 100,000 people (95% UI: 74.4-115.48) in 1990 to 109.07 cases per 100,000 people (95% UI: 86.38-135.76) in 2021, with a rate of increase of 17.15% (Supplementary Table 1, Fig. 1-A).

The number of prevalence cases of gout rose from 22,265,000 (95% UI: 17,793,000-27,966,000) in 1990 to 56,475,000 (95% UI: 45,162,000-70,288,000) in 2021. The ASPR of gout displayed an increasing rate of 21.86% from 536.54 cases per 100,000 people (95% UI: 430.28-665.72) in 1990 to 653.82 cases per 100,000 people (95% UI: 526.13-810.46) in 2021 (Supplementary Table 2, Fig. 1-B).

The estimated number of DALYs cases of gout increased from 698,000 (95% UI: 470,000-1,000,000) in 1990 to 1,748,000 (95% UI: 1,186,000-2,485,000) in 2021. The ASDR of gout displayed an increasing rate of 21.3% from 16.67 cases per 100,000 people (95% UI: 11.25-23.95) in 1990 to 20.22 cases per 100,000 people (95% UI: 13.77-28.77) in 2021 (Supplementary Table 3, Fig. 1-C).

The EAPCs for the prevalence, incidence, and DALYs in 1990-2021 were 0.67 (95% UI: 0.61-0.73), 0.87 (95% UI: 0.8-0.95), and 0.86 (95% UI: 0.78-0.93), respectively (Supplementary Tables 1-3), suggesting that the gout-related GBD continues to increase.

The incidence, prevalence, and DALYs for gout in 1990-2021 increased in both males and females, with increases in ASIR, ASPR, and ASDR in males three times those in females (Fig. 2). In 2021, the number of prevalence cases was 42,130,000 (95% UI: 33,505,000-52,849,000) in males and 14,345,000 (95% UI: 11,462,000-17,901,000) in females, with males far outperforming females in both the number of cases and growth rate (Supplementary Table 2, Fig. S1).

From 1990 to 2021, the 60-94 years old groups had the fastest growth in the incidence, prevalence, and DALYs, and the incidence continued to rise with age (Fig. 3). By 2021, the fastest increases in ASIR and ASPR were seen in the 95+ years old group, and the most significant increase in ASDR was seen in the 85-89 years old group. The number of incidence cases, prevalence cases, and DALYs cases was the largest in the 55-59, 65-69, and 55-59 & 65-69 years old groups (Supplementary Tables 1-3, Figure S2).

Figure 1. Change trends of incidence cases, ASIR (A), prevalence cases, ASPR (B), DALYs cases, and ASDR (C) of gout in 1990-2021

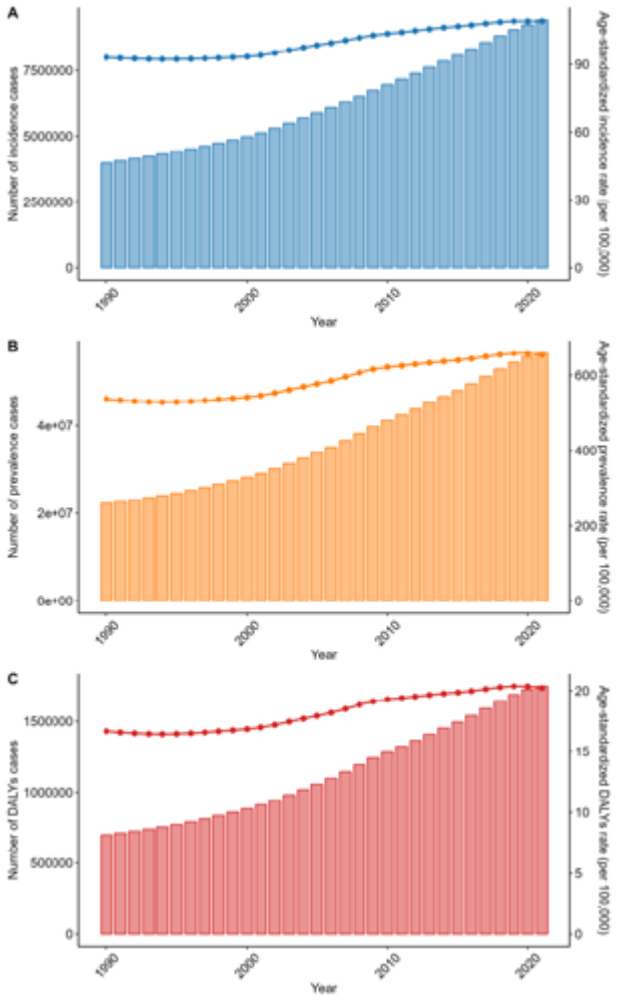

Figure 2. Global ASIR, ASPR, ASDR (A), incidence cases, prevalence cases, and DALYs cases (B) of gout by sex in 1990-2021

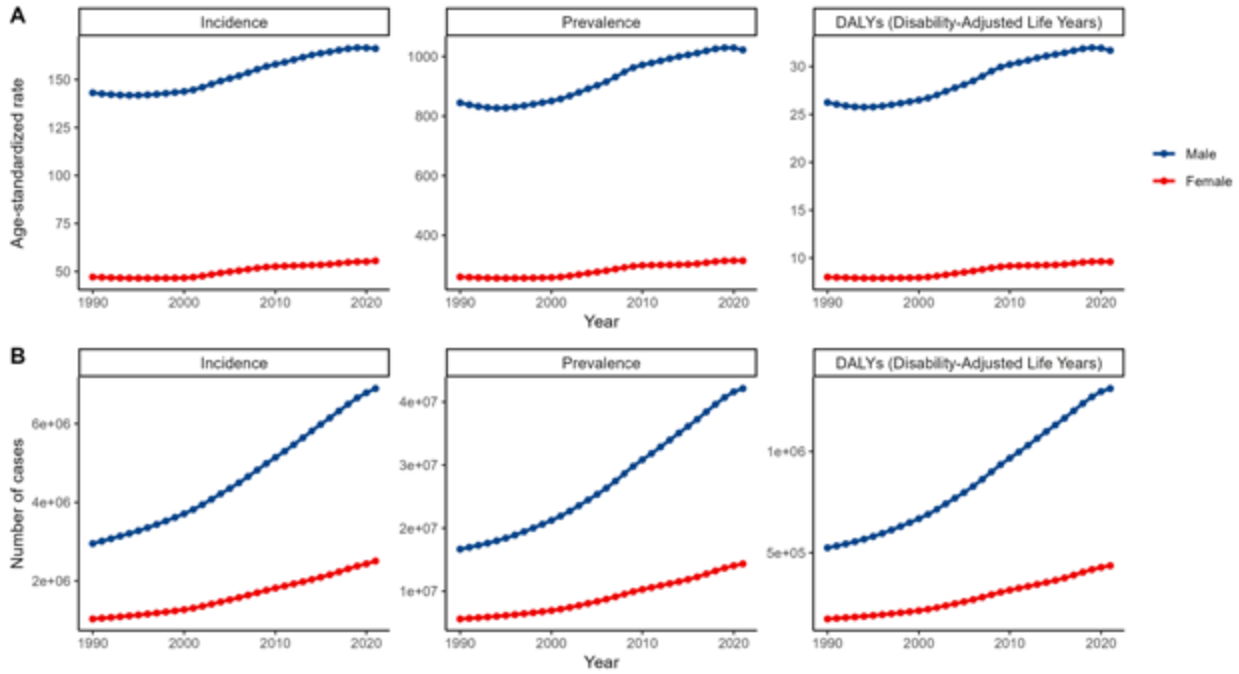

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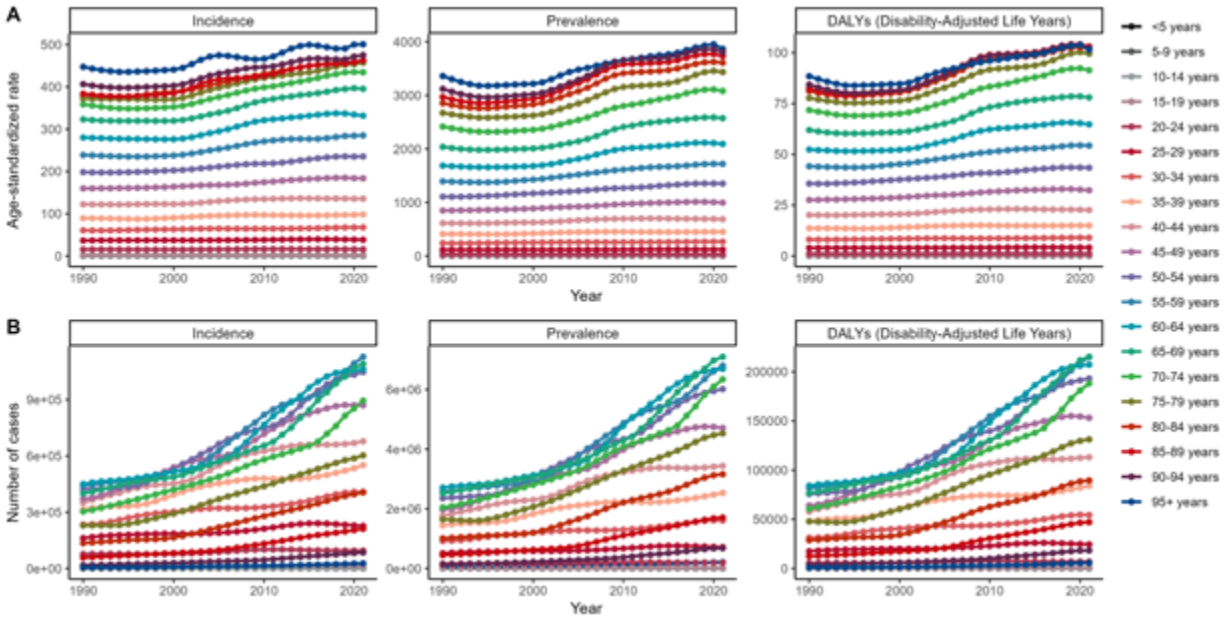
Figure 3. Associations of global gout incidence rate, death rate, and DALY rate with age in 1990 and 2021. ASIR, ASPR, ASDR (A), incidence cases, prevalence cases, and DALYs cases (B)



Gout burden across GBD regions

We thoroughly analyzed and categorized the number of incidence cases, prevalence cases, and DALYs cases of gout globally and across GBD regions, and observed clear data and trends (Fig. 4). We also visualized the EAPCs for the prevalence, incidence, and DALYs for gout (Fig. S3).

The increase or decrease in the number of incidence cases of gout in 1990-2021 significantly varied across territories, including a minor increase in 11 territories, a stable or minor decrease in four territories, a significant decrease in 37 territories, and a significant increase in two territories (Fig. 5).

Particular attention was given to the more economically developed North America, in which the ASIR, ASPR, and DALYs for gout had the most significant increases (Fig. 4). Specifically, the number of prevalence cases and the prevalence rate of gout increased from 3,230,000(95% UI: 2,600,000-4,050,000) and 971.4 cases per 100,000 people (95% UI: 771.5-1216.38) in 1990 to 9,500,000 (95% UI: 7,724,000-11,695,000) and 1658.09 cases per 100,000 people (95% UI: 1349.93-2024.88) in 2021, respectively. It can be seen that the number of gout cases in North America increased by up to 70.7% over the last three decades (Supplementary Table 2).

The increase rate was the lowest in West Africa, from 425.51 cases per 100,000 people (95% UI: 340.81-533.67) in 1990 only to 430.34 cases per 100,000 people (95% UI: 344.91-535.63) in 2021, and the EAPC for the prevalence was even 0 (-0.04 to 0.05) (Supplementary Table 2).

Furthermore, Central Latin America showed the lowest ASIR, ASPR, and DALYs for gout by 2021 (Fig. 6A), and the number of incidence cases, prevalence cases, and DALYs cases was the smallest in Oceania (Fig. 6B). These data present a detailed distribution of the global gout burden, and help further develop targeted public health strategies and interventions.

Figure 4. Changes in global gout burden in 204 countries and territories in 1990-2021. Incidence cases (A), prevalence cases (B), DALYs cases (C)

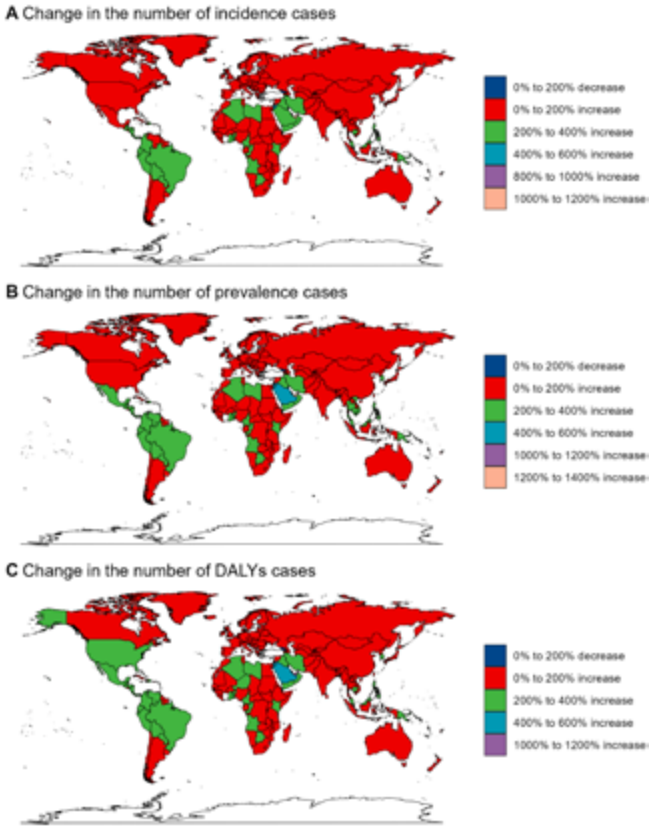


Figure 5. Increase or decrease in the number of incidence cases of gout in 1990-2021 across territories

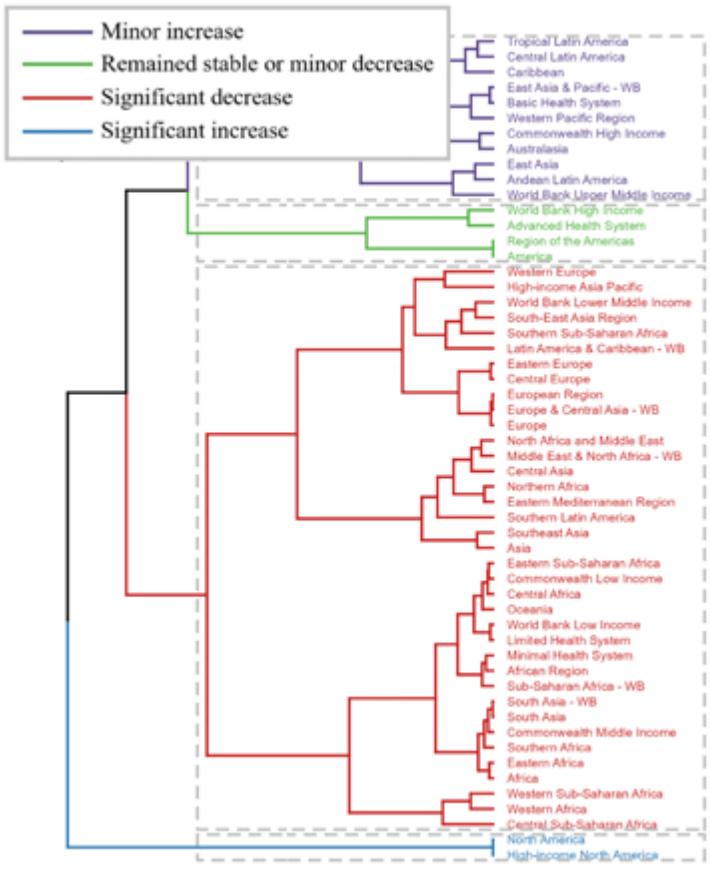


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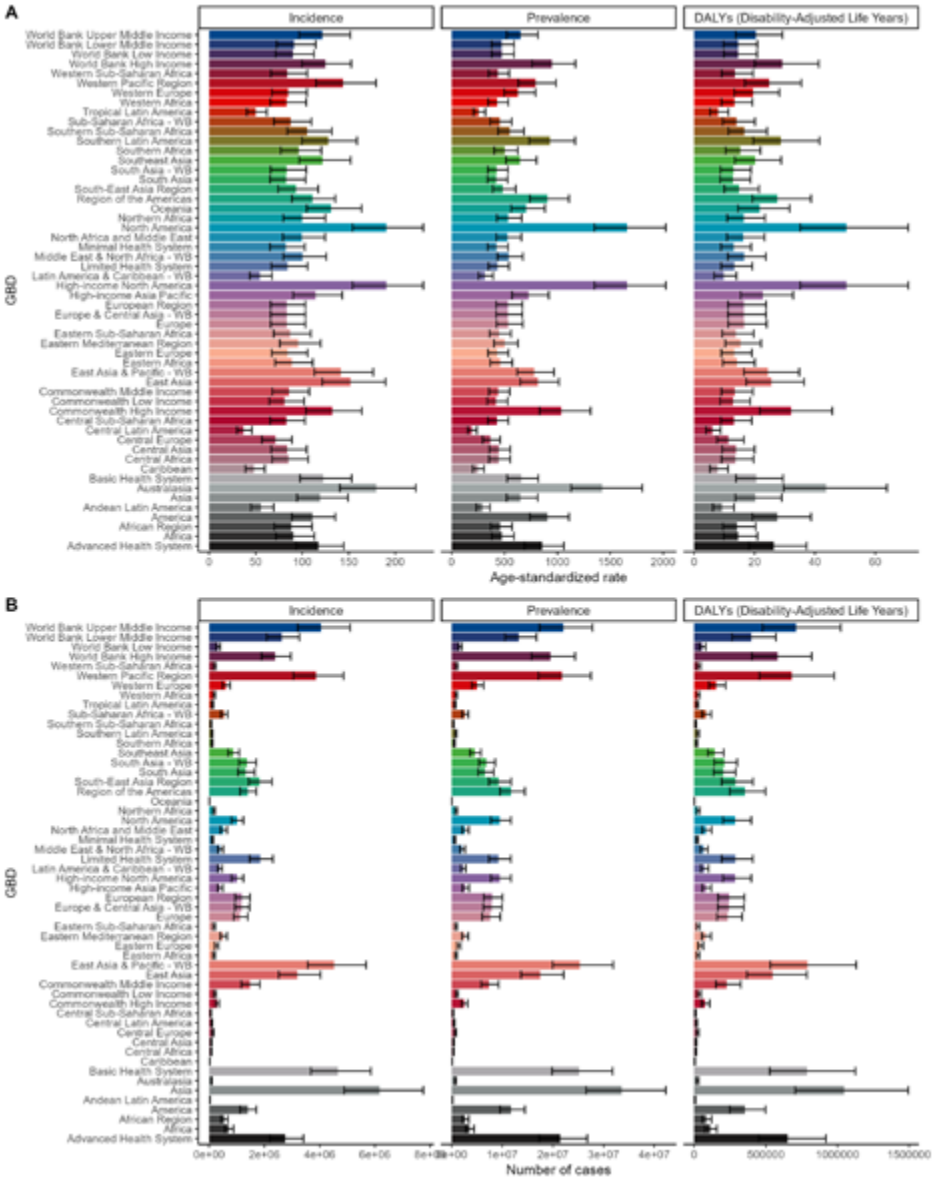
Figure 6. Increase or decrease in ASIR, ASPR, ASDR (A), incidence cases, prevalence cases, and DALYs cases (B) in 2021 across territories



Gout burden across Countries or territories

In 2021, ASIR, ASPR, and ASDR were 191.95 per 100,000 people (95% UI: 155.54-231.03), 1677.1 per 100,000 people (95% UI: 1369.5-2044.08), and 50.95 per 100,000 people (95% UI: 35.36-71.75), respectively, in the United States, achieving the highest increasing rates of 31.33%, 76.28%, and 73.77% in the last three decades (Supplementary Tables 1-3, Fig. S4 A-C). In China, the number of incidence cases, prevalence cases, and DALYs cases was 3,080,000 (95% UI: 2,425,000-3,891,000), 16,788,000 (95% UI: 13,144,000-21,278,000), and 526,000 (95% UI: 353,000-758,000) (Supplementary Tables 1-3, Fig. S4 D-F). The EAPCs for the incidence, prevalence, and DALYs in Nigeria were -0.26 (95% UI: -0.35 to -0.18), -0.25 (95% UI: -0.34 to -0.15), and -0.21 (95% UI: -0.3 to -0.12), respectively, suggesting that the most significant negative growth over time occurs in Nigeria. In addition, negative growth was also found in Nauru, Northern Mariana Islands, Somalia, Sweden, and Zimbabwe, while all other countries or territories showed positive growth (Supplementary Tables 1-3).

Gout burden across SDI regions

ASIR, ASPR, and ASDR all exhibited varying degrees of increase in each SDI region in 1990-2021. Specifically, the high SDI region showed the most significant growth in ASIR, ASPR, and ASDR by 27.83%, 43.07%, and 41.9%, respectively, in the last three decades (Supplementary Tables 1-3 and Fig. S5). By 2021, the three indicators all reached the peak in the high SDI region (Fig. S6A). In 2021, the number of incidence cases was the largest in the middle SDI

region, and the number of prevalence cases and DALYs cases was the largest in the high SDI region (Fig. S6B). In contrast, both the number of cases and the growth rate reached the bottom in the low SDI region compared with the other SDI groups in terms of disease prevalence and negative impacts on quality of life (Fig. 6). To sum up, the population health status is undergoing changes in different SDI regions in the context of global economic and social development, with the high SDI region facing serious health challenges.

Decomposition analysis of gout burden

This study conducted an in-depth analysis of the change trends of the incidence, prevalence, and DALYs for gout globally and in five SDI regions between 1990 and 2021, followed by a detailed decomposition analysis. This study intends to assess the specific impact of aging, epidemiological changes, and population growth on the gout burden. The results revealed that the overall global gout burden displayed a significant increasing trend in 1990-2021.

Specifically, population growth was the key driver of the increasing gout burden globally. Population growth was responsible for 52.31%, 47.72%, and 48.5% of the annual increase of incidence, prevalence, and DALYs, respectively, in 1990-2021, as verified by the graphs and decomposition tables. Besides, the impact of population growth on the gout burden was particularly significant in the low SDI region, responsible for 92.53%, 93.06%, and 92.22% of the increase in incidence, prevalence, and DALYs, respectively.

Furthermore, the impact of population aging on the gout burden was most significant in the middle SDI region and less significant in the low SDI region. Based on the data in 2021, nonetheless, its impact on the incidence, prevalence, and DALYs in the low SDI region showed no increasing trends.

Finally, the impact of epidemiological change on the three indicators was most significant in the high SDI region, suggesting their non-negligible impact on the overall gout burden in the high SDI region. In the low SDI region, the epidemiological change had some influence on the gout prevalence (Supplementary Tables 4-6, Fig. S7).

Frontier analysis of gout burden

The effective difference (EF) is explicitly defined as a measure of the gap of a country or territory from the level of health at the global frontier. Based on the SDI, this indicator assesses the difference between the actual health burden observed and the lowest theoretically achievable burden of disease. With the help of EF, we can not only reveal the specific position of countries or territories during the development of the gout burden but highlight the possible benefits achievable and room for improvement.

Our in-depth analysis revealed a remarkable trend: The EF value tended to decline as the SDI gradually increased, signifying that the gap in the health burden and the disease burden of a country or territory is gradually narrowing, and the variability of this trend is also decreasing (Fig. S8). Most importantly, the frontier trends of ASIR, ASPR, and ASDR all became more stable when the SDI crossed the threshold (0.4).

To further present a clear picture of the gap of a country and territory from the global frontier, we estimated the EF and plotted graphs based on the 2021 data on ASIR, ASPR, ASDR, and SDI (Supplementary Table 7, Fig. S8. The black solid line outlines the global frontier, while the dots represent different countries and territories). As marked by blue dots, the gap in the health burden and the disease burden was narrowing in some countries or territories such as Somalia, Chad, Central African Republic, and Mali, reflecting a favorable development trend. In contrast, such a gap was widening in the United States, Canada, New Zealand, and Australia, as marked by red dots. These findings greatly contributed to our in-depth understanding of the health development status of countries and territories, and their relative position to the global frontier.

DISCUSSION

Through a comprehensive analysis of the global gout burden in 1990-2021, this study revealed complex differences and trends in the gout burden across countries and territories and SDI regions. The results showed that ASIR, ASPR, and age-standardized DALY rates of gout were all on the rise globally. The total number of gout patients more than doubled from 1990 to 2021, and the prevalence increased in most GBD regions, consistent with previous GBD studies that the ASPR of gout increases over time [19, 20]. ASPR, ASIR, and age-standardized DALY rates were all at their highest levels in the high SDI region and lower in the low SDI region. This finding highlights the persistent socioeconomic disparities in the global gout burden, suggesting that gout is not only a widespread medical and rheumatologic problem but an increasingly prominent socioeconomic issue [21]. In the high and high-middle SDI regions, the great gout burden may be associated with the potential of gout in chronic continuous joint destruction and with cardiometabolic and renal diseases (hypertension, myocardial infarction, stroke, obesity, type 2 diabetes mellitus, hyperlipidemia, hyperuricemia, and chronic kidney disease) [22, 23]. The prevalence of these diseases is also higher in highly developed areas. Therefore, despite a perfect healthcare system and effective public health interventions in high SDI regions, optimization of nutrition and lifestyle and medications for adequate prevention and treatment

and lowering serum uric acid (SUA) are an integral part of comprehensive gout management [24].

The sex and age distribution of gout patients exhibits statistically significant differences. It was found in this study that males had significantly higher prevalence, incidence, and DALY rates than females, consistent with previous studies [19, 21]. Notably, the global prevalence and burden of disability increased disproportionately in females with gout compared with males. Female gout patients are characterized by higher rates of obesity and associated cardiometabolic sequelae [25, 26]. Obesity is recognized as a major risk factor for gout and hyperuricemia [27-29], which elevates SUA levels and raises the gout risk by decreasing uric acid excretion and promoting uric acid production [30-35]. According to a supplementary analysis of randomized dietary intervention trials, a healthy slimming diet can help reduce SUA levels, particularly in patients with baseline hyperuricemia [36]. Furthermore, bariatric surgery is linked to decreases in SUA levels and incidence of gout and hyperuricemia [37, 38]. Recently, a sex-specific cohort study further pointed out that excess fat is associated with the risk of gout in both males and females, in line with our finding of a more obvious out-of-standard BMI in females[38]. Therefore, social strategies to assist females in achieving and maintaining a healthy weight may have positive implications for reducing the incidence of gout in females.

The gout burden showed an increasing trend from 1990 to 2020 in most regions, and the incidence, prevalence, and DALYs for gout greatly varied across regions due to environmental factors [39-41]. In high-income regions, the rise in age-standardized DALY rate may be partly attributed to high exposure to gout risk factors, such as renal dysfunction and high BMI. The average annual incidence of gout resulting from renal dysfunction remains high in high-income countries in the Asia-Pacific region, and it is reported that these countries have a higher incidence of renal dysfunction. Moreover, it further increases with age, worsening the gout burden [42]. Obese patients (BMI >30 kg/m^2) have more than twice the risk of developing gout compared with people with BMI <30 kg/m^2 [43]. Purine-rich foods, such as fish (anchovies, sardines, scallops, and mussels) and meat (bacon, beef, liver, turkey, veal, and venison), are one of the risk factors for gout. Beer is more significantly associated with an increased risk of gout than wine or spirits. The risk of gout in males will rise in case of daily consumption of two or more sugary soft drinks, high-fructose fruits, or any fruit juices [9]. However, the impact of potential racial differences on gout incidence also varies in high-income regions, as previous studies argued that African Americans possess a higher risk of gout [44-46] and lower health-related quality of life compared with white Americans [47]. The potential reasons may be attributed primarily to differences in non-genetic social determinants [48], such as poverty and poor dietary habits, which may influence the BMI. Research suggests that all risk factors for gout and hyperuricemia are more prevalent in black adults than in white adults, and that the former is younger and less educated and has higher rates of poverty. This indicates that racial differences in sociodemography, lifestyle, and clinical factors are more important [49], and blacks have less access to health care [50]. Traditionally, gout has been recognized as a disease of affluent men ("disease of kings") [51], but given the associations of socioeconomic status, food insecurity, diet quality, and obesity, the burden of gout-related cardiometabolic and renal sequelae now becomes extremely high in low-income people. To reduce racial differences in the prevalence of gout and hyperuricemia, we can popularize a healthy dietary pattern such as that described in the *Dietary Guidelines for Americans* [52], and reduce barriers to adherence [53], including interventions for people receiving Supplemental Nutrition Assistance Program benefits (who typically have poorer diet quality than others) [54].

The decomposition and frontier analyses revealed that population growth was the key driver of the increasing gout burden globally, and the burden was borne primarily by developed countries with stronger coping capacities. However, measures can be taken to reduce the gout burden across countries and territories with different levels of development and within the same country and territory at different stages of development. Economically developed countries such as the United States and Canada bore more gout burden, highlighting a major challenge for healthcare systems. Significant EF was present between gout-related DALYs and the global frontier in some countries, suggesting room for improvement. Although health losses due to gout are associated with socioeconomic and demographic indicators, some developing countries performed well in gout-related DALYs in the frontier analysis, which could provide a useful reference for developed countries. The increasing gout burden should be incorporated into global and national health agendas to help reduce the number of patients in more regions and the risk of gout and other complications.

Limitations

Several limitations are worth noting. First, the gout burden estimates of GBD deviated from the actual data due to the diversity of data sources and heterogeneity of quality. Specifically, the gout burden in low- and middle-income regions may be underestimated due to the uneven distribution of healthcare resources. Second, based on the requirement of GBD, only high BMI and renal dysfunction were included as risk factors for gout because only their causality with gout has been proved by sufficient population-based evidence. However, there are also other risk factors such as hyperuricemia, fasting plasma glucose, genetic factors, cardiovascular disease, diabetes, drinking, and diet involving the

intake of purine-rich foods (red meat and seafood) and high-fructose beverages. It is worth noting that GBD currently includes consumption of red and processed meats and drinking as risk factors for other diseases such as cardiovascular disease [55]. However, the evidence for causality between these factors and gout remains to be evaluated. Third, although the relation between DALYs and SDI can be explained, it cannot be considered causality.

FUNDING

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CONFLICTS OF INTEREST

The authors declare no competing interests.

ETHICS APPROVAL

Not applicable-The GBD 2021 study is an open database, and all data is anonymous.

CONSENT TO PARTICIPATE

Not applicable

CONSENT FOR PUBLICATION

Not applicable

AVAILABILITY OF DATA AND MATERIAL

The data for this study were obtained from the GBD database (http://ghdx.healthdata.org/gbd-results-tool).

CODE AVAILABILITY

Not applicable.

AUTHORS' CONTRIBUTIONS

Fangfang Deng and Bo Chen conceived and designed the study; Fangfang Deng, Fan Hu, and Huali Guo analyzed and visualized the data. Fangfang Deng wrote the draft of the manuscript. All authors read and approved the final manuscript.

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