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Trends and projections of the burden of osteoarthritis disease in China and globally: A comparative study of the 2019 global burden of disease database

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ABSTRACT

This study aims to characterize the burden of osteoarthritis in China and globally from 1990 to 2019 and predict the burden for the next decade. The Global Burden of Disease (GBD) database is designed to assess the burden of various diseases and injuries on a global scale. Age-standardized rate data for the incidence, prevalence, and Years Lived with Disability (YLDs) of osteoarthritis in both China and the global context were extracted. Furthermore, the Estimated Annual Percentage Change (EAPC) to illustrate the long-term trends in the burden of osteoarthritis disease was calculated. Autoregressive integrated moving average (ARIMA) models were applied to forecast the trends in age-standardized incidence rate (ASIR), age-standardized prevalence rate (ASPR), and age-standardized YLDs rate (ASYR) for osteoarthritis in China and globally for the next 11 years. Knee osteoarthritis showed a changing trend of ASIR, ASPR, and ASYR from 1990 to 2019 in China, initially decreasing and then increasing. In contrast, global osteoarthritis exhibited a relatively stable overall trend over three decades. Knee osteoarthritis exhibited the highest incidence, prevalence, and YLDs across various age groups and genders. The ARIMA forecast indicated a slight upward trend in osteoarthritis burden in China and globally over the next 11 years. Osteoarthritis poses a significant health issue, emphasizing the need to enhance awareness and management of osteoarthritis among the population and policymakers, particularly focusing on the elderly and female populations.

1. Introduction

Osteoarthritis is a chronic degenerative joint disease, traditionally described as a "wear and tear" condition, involving various physiological changes in the joints and surrounding tissues. It primarily leads to progressive damage to joint cartilage, subchondral bone, and synovial structures (Hunter and Bierma-Zeinstra, 2019). Clinical manifestations include pain, stiffness, swelling, and limited joint function, significantly restricting patients' social activities and reducing their quality of life (Kolasinski et al., 2020). Globally, the trend shows that from 1990 to 2019, the years lived with disability (YLDs) due to osteoarthritis increased by 114.5 % (GHDx, 2019). Osteoarthritis commonly affects the knee joints, hand joints, and hip joints. The upper part of the knee joint is particularly vulnerable to both direct (impact) and indirect (twisting) trauma, bearing high loads, making it one of the most commonly affected joints in osteoarthritis (Cooper et al., 2000; Madaleno et al., 2018). According to YLDs measurements, hip and knee osteoarthritis rank 11th globally in terms of disability. However, the prevalence of hand osteoarthritis varies widely in different studies (Peat et al., 2020; Haugen et al., 2011), and there is no consistent conclusion. Over the years, various risk factors for osteoarthritis have been identified, such as old age, female gender, overweight/obesity, joint injuries, genetic susceptibility, and occupational factors. These factors increase the risk of developing joint disorders like knee and hip arthritis (Silverwood et al., 2015; Blagojevic et al., 2010; Canetti et al., 2020; Spector and MacGregor, 2004).

Osteoarthritis is not only related to patients' high health burden but also has a huge impact on the healthcare system (Hunter et al., 2014). Due to the heavy burden of osteoarthritis, its early detection and prevention, treatment, and management have always been the focus of research. Therefore, it is urgent to understand the epidemiology of osteoarthritis and identify relevant demographic factors. Only with an accurate understanding of the number and distribution of patients, can the formulation of relevant policies be more scientific. Currently,

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relevant studies report on the burden of osteoarthritis in China, such as a *meta*-analysis study involving 74,908 participants in China that investigated the prevalence of symptomatic knee osteoarthritis in patients (Li et al., 2020). However, due to the uneven coverage of all cities in China by the studies included, there may be data biases, and the recent burden of osteoarthritis in China may not be fully described. Relevant literature has reported the results of a study on the basic burden of osteoarthritis in China from 1990 to 2019 based on the GBD database (Liu et al., 2022). However, this study only focused on the burden of knee and hip osteoarthritis caused by BMI and did not comprehensively analyze the relevant trends of total osteoarthritis and different types of osteoarthritis burden in China. In addition, there is no research on predicting the burden of osteoarthritis in China and globally in the next 11 years. Therefore, based on the GBD 2019 database, we analyzed the incidence, prevalence, and YLDs burden of osteoarthritis in China and globally over the past 3 decades, and predicted the trend of osteoarthritis burden in the next 11 years through autoregressive integrated moving average (ARIMA) model, to provide reference data for reallocating limited medical resources and innovating osteoarthritis prevention and treatment strategies.

2. Methods

2.1. Data sources

During the period from 1990 to 2019, data on the incidence, prevalence, YLDs, and corresponding age-standardized rates (Age-standardized incidence rate, ASIR; Age-standardized prevalence rate, ASPR; Age-standardized YLDs rate, ASYR) for osteoarthritis, including hand osteoarthritis, hip osteoarthritis, knee osteoarthritis, and other joint disorders, were obtained for China and globally from the Global Burden of Disease (GBD) estimates provided by the World Health Organization (https://ghdx.healthdata.org/). The data were accessed on May 9, 2023. GBD 2019 offers estimates for 369 diseases and injuries, 87 risk factors, and rates for incidence, prevalence, mortality, years of life lost, years lived with disability, disability-adjusted life years (DALYs), and their corresponding 95 % uncertainty intervals (UI) for 204 countries and regions.

The reference case definition for osteoarthritis was symptomatic osteoarthritis with radiographic confirmation of Kellgren-Lawrence grade 2–4. Grade 2 symptoms required the presence of an osteophyte in the affected joint and pain for at least 1 month in the past 12 months. Grade 3–4 symptoms required the presence of osteophytes, joint space narrowing, and, in grade 4, deformity, in the affected joint, and pain for at least 1 month in the past 12 months (Diseases and Injuries, 2020). For this study, we used a publicly available, anonymous database and therefore not subject to ethical constraints, and we obtained an exemption statement from the Institutional Review Board.

2.2. Statistical analysis

This study screened the incidence, prevalence, YLDs, and corresponding age-standardized rates (ASRs) of osteoarthritis in China and globally based on the GBD database. To identify the trends in incidence rate, prevalence rate, and YLDs rate of osteoarthritis, the estimated annual percentage change (EAPC) was calculated to describe the long-term trend of ASRs of osteoarthritis burden based on regression models. The method involved fitting the natural logarithm of the ratio of ASRs to calendar year, i.e., $y = \alpha + \beta x + \varepsilon$, where $y = \ln(\text{ratio})$, $x =$ calendar year, and $\varepsilon =$ error term. In this formula, β represents the positive or negative trend of ASRs. The EAPC and its 95 % CI were calculated using the formula $100 \times (\exp(\beta) - 1)$. If the EAPC value and the lower limit of the 95 % CI were greater than 0, the ASR was deemed increased. If the EAPC value and the upper limit of the 95 % CI were less than 0, the ASR was deemed decreased. A constant trend was observed when the 95 % CI of the EAPC was equal to 0.

We employed an ARIMA (p, d, q) model to forecast the trends of ASIR, ASPR, and ASYR for osteoarthritis in China and globally from 2020 to 2030. The letters p, d, and q respectively denote the autoregressive, differencing, and moving average components of the ARIMA model. The ARIMA equation is as follows:

- Autoregressive Component (AR): It reflects the relationship between the current value of a time series and past values at various time points, aiming to capture the autocorrelation within the sequence. The AR component is typically denoted as p, representing the consideration of p lags.

  $AR(p) = \varphi1*Y(t-1) + \varphi2*Y(t-2)++\varphi p* Y(t-p)$.

  Here, Y(t) represents the value of the time series at time t, and $\varphi1$, $\varphi2$, …, φp are autoregressive coefficients.

- Differencing Component (I): It signifies differencing the time series to make it stationary for ARIMA model application. The I component is typically represented as d, indicating the number of differencing steps.

  $I(d) = (1 - B)\hat{}d * Y(t)$.

  Here, B is the differencing operator, and Y(t) is the differenced time series.

- Moving Average Component (MA): It characterizes the relationship between the current value and past error terms at various time points, capturing the lagged error correlation within the sequence. The MA component is typically denoted as q, indicating the consideration of q lagged error terms.

  $MA(q) = \theta1 * \varepsilon(t-1) + \theta2 * \varepsilon(t-2) + \ldots + \theta q * \varepsilon(t-q)$.

  Here, $\varepsilon(t)$ represents the error terms of the time series, and $\theta1$, $\theta2$, …, θq are the moving average coefficients.

To apply the ARIMA model, we first used the Augmented Dickey-Fuller (ADF) test to determine if the series is stationary. If the ADF test results are significant, the series is considered stationary. Subsequently, the parameters of the ARIMA model are tentatively determined based on the shapes of the autocorrelation function (ACF) and partial autocorrelation function (PACF). The ARIMA function was used to select the optimal model with the lowest Bayesian Information Criterion (BIC) and the highest R (Kolasinski et al., 2020) value (coefficient of determination, a statistic indicating the goodness of fit of the model). Ljung-Box Q test, ACF, and PACF are used to assess the residuals to check if they meet the requirements of a white noise sequence. After the constructed model was tested for white noise and passed, the model was applied to predict the ASIR, ASPR, and ASYR of osteoarthritis in 2020–2030. The modeling was conducted using the "auto.arima" package in Python and statistical analysis in R software (version 4.2.3) and Python (version 3.10). In this study, significance was defined as $p < 0.05$.

3. Results

3.1. Trends in osteoarthritis burden in China and globally from 1990 to 2019

The overall burden of osteoarthritis in China and globally showed an upward trend. The EAPC for China's ASIR of osteoarthritis from 1990 to 2019 is 0.36 (95 % CI: 0.29–0.44). The EAPC of global ASIR was 0.16 (95 %CI: 0.15–0.18). The EAPC in ASPR and ASYR of osteoarthritis in China were 0.35 (95 %CI: 0.28–0.42) and 0.40 (95 %CI: 0.32–0.48), respectively, while those in global ASPR and ASYR were 0.12 (95 %CI: 0.11–0.14) and 0.14 (95 %CI: 0.12–0.16), respectively. Among the four types of osteoarthritis analyzed in this study, Hand Osteoarthritis in both China and globally showed a declining trend in Age-Standardized

Incidence Rate (ASIR), Age-Standardized Prevalence Rate (ASPR), and Age-Standardized Years Lived with Disability Rate (ASYR) from 1990 to 2019. Both China and global trends in the EAPC for Knee Osteoarthritis indicate an upward trajectory in ASIR, ASPR, and ASYR. A similar increasing trend is observed for Hip Osteoarthritis and other joint types (EAPC > 0) in ASIR, ASPR, and ASYR. Additionally, the incidence, prevalence, and YLDs of knee osteoarthritis were substantially higher than those of other types of osteoarthritis, and similar trends were observed globally (Table 1; for global data, see Supplementary Table 1).

From the analysis of the trends in ASR in Fig. 1, knee osteoarthritis had the highest ASIR (Fig. 1a), ASPR (Fig. 1b), and ASYR (Fig. 1c) among all subtypes of osteoarthritis in China, followed by hand osteoarthritis, but its disease burden was much lower than that of knee osteoarthritis. The ASIR of osteoarthritis in China fluctuated slightly from 1990 to 1999 and showed a slight decrease, from 472.53/100,000 (95 %UI: 417.53–531.42) to 469.34/100,000 (95 %CI: 416.41–527.39), but rapidly increased from 1999 to 2006 to 511.47/100,000 (95 %CI: 454.22–574.54) (Supplementary Table 2) and has shown a small upward trend since 2006. The global ASIR (Fig. 1d), ASPR (Fig. 1e), and ASYR (Fig. 1f) of osteoarthritis presented a relatively flat trend during 1990–2019.

3.2. Disease burden of osteoarthritis in China and globally in 2019 by age and gender

According to the results from Fig. 2(a-c, g-i) for China, in 2019, the highest incidence, prevalence, and female Years Lived with Disability (YLDs) for osteoarthritis (OA) were concentrated in the age group of 50–54, while the age group with the highest male YLDs was 55–59 (see Supplementary Table 3). Overall, the incidence, prevalence, and YLDs of osteoarthritis increased with age and then decreased. Furthermore, the disease burden of osteoarthritis was higher in females than in males. Knee osteoarthritis had the highest incidence, prevalence, and YLDs among all age groups and genders.

Fig. 3a–c presents global data, showing that the incidence trend of osteoarthritis in 2019 followed a similar pattern to that in China. It increased with age, peaked around the age of 50–54, and then gradually declined. However, unlike China, the highest number of cases (Fig. 3d-f) and YLDs (Fig. 3g-i) in the global context occurred in the age group of 60–64. Osteoarthritis exhibited significant gender disparities, with a much higher burden in females compared to males. Among different types of arthritis, knee osteoarthritis bore the most significant burden, followed by hand arthritis, other osteoarthritis, and hip arthritis. For detailed data, please refer to Supplementary Table 3.

3.3. Future 11-year burden of osteoarthritis in China and globally

This study utilized GBD data from 1990 to 2019 to forecast the ASIR, ASPR, and ASYR of osteoarthritis in China and globally for the next 11 years using the ARIMA model. The results were presented in Fig. 4. The forecasted outcomes revealed that the trends for ASRs of osteoarthritis in both China and the global context were expected to remain relatively stable over the next 11 years. The model selection was conducted using the “auto.arima” function in Python, and the Ljung-Box Q test was applied to examine the residual sequence of the ARIMA model. No autocorrelation was detected, confirming the robustness of the ARIMA model. The residuals were white noise ($p > 0.05$), indicating a good fit of the ARIMA model (Supplementary Table 4). Among all types of osteoarthritis, knee osteoarthritis continued to impose the most significant disease burden, followed by hand osteoarthritis.

4. Discussion

This is the first comprehensive study on burden of osteoarthritis and its affected sites, including hand, hip, knee, and other joint diseases, in China and globally. Our research found that from 1990 to 2019, ASIR, ASPR, and ASYR of osteoarthritis in China and globally presented an increasing trend, and the upward trend was higher in China than globally, indicating a severe burden of osteoarthritis in China. Knee osteoarthritis was the most serious disease burden among all types of osteoarthritis in China and globally. Looking at the overall trend, the disease burden of osteoarthritis in China showed a downward trend followed by an upward trend, while the overall trend of osteoarthritis globally was relatively flat, showing a slight upward trend.

According to the GBD estimates in 2017, the ASPR, ASIR, and ASYR for symptomatic, radiologically confirmed osteoarthritis globally were 3754.2 per 100,000, 181.2 per 100,000, and 118.8 per 100,000, respectively (Safiri et al., 2020). According to the results of this study, the global OA disease burden data in 2019 increased significantly compared with 2017, and the global OA disease burden is still expanding, consistent with the results of previous studies (Safiri et al., 2020; Cross et al., 2014). Furthermore, research data indicated that age-standardized DALYs rate (ASDR) for osteoarthritis was correlated with Socio-Demographic Index levels and geographical locations in different countries and regions, possibly due to variations in socioeconomic status, geographic location, and access to healthcare services among different countries. The influence of diagnostic techniques and medical advancements on the results cannot be ignored, as they are related to disease identification and more accurate case reporting (Darbandi et al., 2023). Moreover, the ARIMA predictions in this study indicated a heavy burden of osteoarthritis in China and globally over the next 11 years. This result aligns with a study that used data from the Swedish National Board of Health and Welfare, predicting osteoarthritis prevalence rates up to 2032 (Turkiewicz et al., 2014). This situation represents a public health crisis, imposing significant socioeconomic burdens on society and healthcare systems. Therefore, there is an urgent need for rigorous, high-quality epidemiological research on osteoarthritis to ensure the formulation of scientifically sound prevention and control policies (Dantas et al., 2021).

Obesity increases the risk of developing osteoarthritis in weight-bearing joints like the knees and non-weight-bearing joints like the hands. Compared to individuals with a normal BMI, obesity doubles the lifetime risk of symptomatic osteoarthritis (Murphy et al., 2008). Currently, over 50 % of adults and approximately 20 % of school-aged children in China are overweight or obese. Over the past 20 years, the rates of overweight and obesity in China have rapidly increased, likely due to the country’s rapid socioeconomic development leading to improved living standards and significant lifestyle changes, such as reduced physical activity and consumption of high-fat diets, refined carbohydrates, and high-calorie foods(Chinese Nutrition Society Obesity et al., 2022). This escalating obesity problem has exacerbated the burden of osteoarthritis. Weight reduction is a well-known effective approach to control issues related to high BMI, including obesity. Professional organizations have developed osteoarthritis management guidelines that provide patients with education on arthritis-related knowledge, weight reduction strategies, and non-pharmacological interventions like exercise (such as yoga or tai chi) (Bannuru et al., 2019; Fernandes et al., 2013; Jevsevar, 2013; Giorgino et al., 2023).

Most of the burden of osteoarthritis is related to knee osteoarthritis, which can lead to progressive disability and may necessitate joint replacements (AOANJRR, 2020). Data from the Australian Orthopaedic Association National Joint Replacement Registry shows that the rates of hip and knee replacement surgeries are 1.9 % and 1.3 %, respectively (Price et al., 2018). Knee replacement surgery is one of the most commonly performed musculoskeletal surgeries, primarily indicated for painful knee osteoarthritis and decreased function and quality of life (Wright et al., 2010). Moreover, knee osteoarthritis patients incur significantly higher medical expenses compared to non-knee osteoarthritis patients, largely attributed to joint replacements(Quality), imposing a substantial economic burden on osteoarthritis patients (Kopec et al., 2007).

This study found that the burden of knee osteoarthritis in China

Table 1
Incidence, prevalence and YLDs of osteoarthritis cases at all ages in 1990 and 2019 in China.

Cause	Measure	Incidence		Prevalence		YLDs	
	Years	All-ages cases, n (95 % UI)	Age-standardized rates per 100,000 people, (95 % UI)	All-ages cases, n (95 % UI)	Age-standardized rates per 100,000 people, (95 % UI)	All-ages cases, n (95 % UI)	Age-standardized rates per 100,000 people, (95 % UI)
Osteoarthritis	**1990**	4,590,967 (4,044,932–5,178,960)	472.53 (417.53–531.42)	51,760,492 (45,946,300–58,263,041)	5,880.58 (5,247.78–6,570.39)	1,819,338 (903,102–3,648,574)	206.38 (103.14–414.41)
	2019	10,681,311 (9,375,594–12,079,546)	509.84 (450.68–573.65)	132,807,006 (117,994,900–149,081,987)	6,330.06 (5,657.28–7,085.42)	4,724,885 (2,347,243–9,536,082)	224.78 (112.45–452.3)
	1990–2019 EAPC (95 % CI)	0.36 (0.29–0.44)		0.35 (0.28–0.42)		0.40(0.32–0.48)	
Osteoarthritis hand	**1990**	438,451 (327,147–592,527)	45.66 (34.52–61.37)	6,989,897 (5,054,131–9,635,408)	828.04 (604.03–1130.24)	48,358 (22,107–98,907)	26.08 (12.91–54.45)
	2019	1,097,965 (815,105–1,482,496)	52.71 (39.69–70.52)	19,637,408 (14,317,682–26,649,670)	953.81 (701.18–1,284.56)	153,025 (70,238–319,576)	30.12 (14.75–62.79)
	1990–2019 EAPC (95 % CI)	−0.27 (-0.65–0.11)		−0.15 (-0.49–0.2)		−0.14 (-0.48–0.2)	
Osteoarthritis hip	**1990**	81,540 (59,899–106,021)	8.29 (6.11–10.79)	1,503,678 (1,148,134–1,911,934)	172.51 (132.2–218.93)	222,254 (108,157–469,746)	5.49 (2.53–11.26)
	2019	243,109 (177,944–319,068)	11.42 (8.42–14.88)	4,787,069 (3,667,374–6,064,140)	234.09 (179.83–296.98)	623,067 (304,033–1,298,390)	7.46 (3.43–15.48)
	1990–2019 EAPC (95 % CI)	1.25 (1.14–1.35)		1.16 (1.06–1.26)		1.16 (1.06–1.26)	
Osteoarthritis knee	**1990**	3,683,886 (3,175,287–4,208,424)	377.2 (326.83–429.76)	42,570,836 (36,337,789–49,302,893)	4,797.01 (4,111.58–5,535.59)	1,365,167 (671,564–2,805,800)	152.74 (75.27–312.9)
	2019	8,425,777 (7,233,585–9,675,256)	402.3 (347.17–459.9)	108,120,120 (91,899,241–125,849,501)	5,125.46 (4,385.13–5,925.24)	3,464,753 (1,688,168–7,064,613)	163.7 (80.1–333.88)
	1990–2019 EAPC (95 % CI)	0.45 (0.35–0.55)		0.48 (0.37–0.6)		0.5 (0.38–0.61)	
Osteoarthritis other	**1990**	387,090 (301,842–480,936)	41.37 (32.73–51.15)	5,784,078 (4,284,793–7,448,528)	702.35 (531.15–890.45)	183,558 (88,122–378,718)	22.07 (10.78–46.01)
	2019	914,459 (710,383–1,145,920)	43.41 (34.2–53.67)	15,280,407 (11,352,174–19,624,729)	745.83 (563.13–950.26)	484,040 (234,460–1,006,720)	23.5 (11.45–49.1)
	1990–2019 EAPC (95 % CI)	0.18 (0.17–0.2)		0.23 (0.22–0.25)		0.24 (0.22–0.25)	

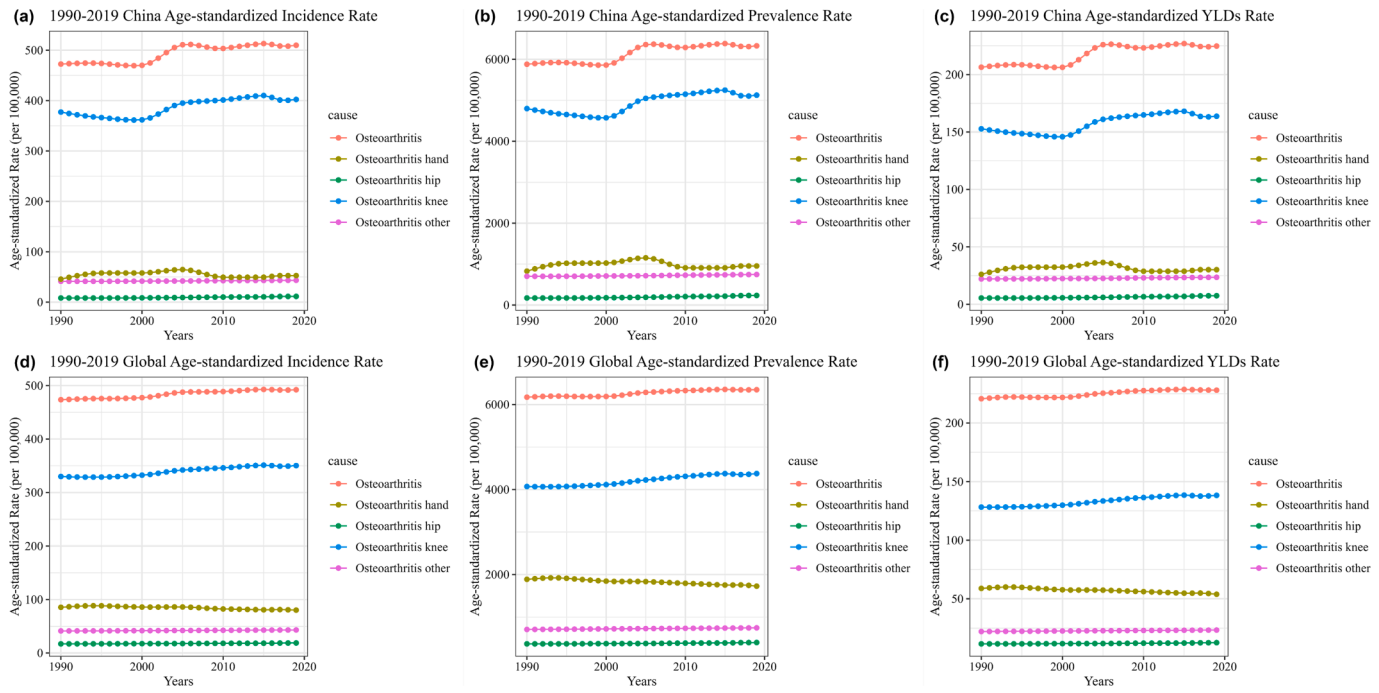

Fig. 1. Trends in ASIR, ASPR, and ASYR for osteoarthritis in China and globally from 1990 to 2019, including hand, hip, knee, and other osteoarthritis.

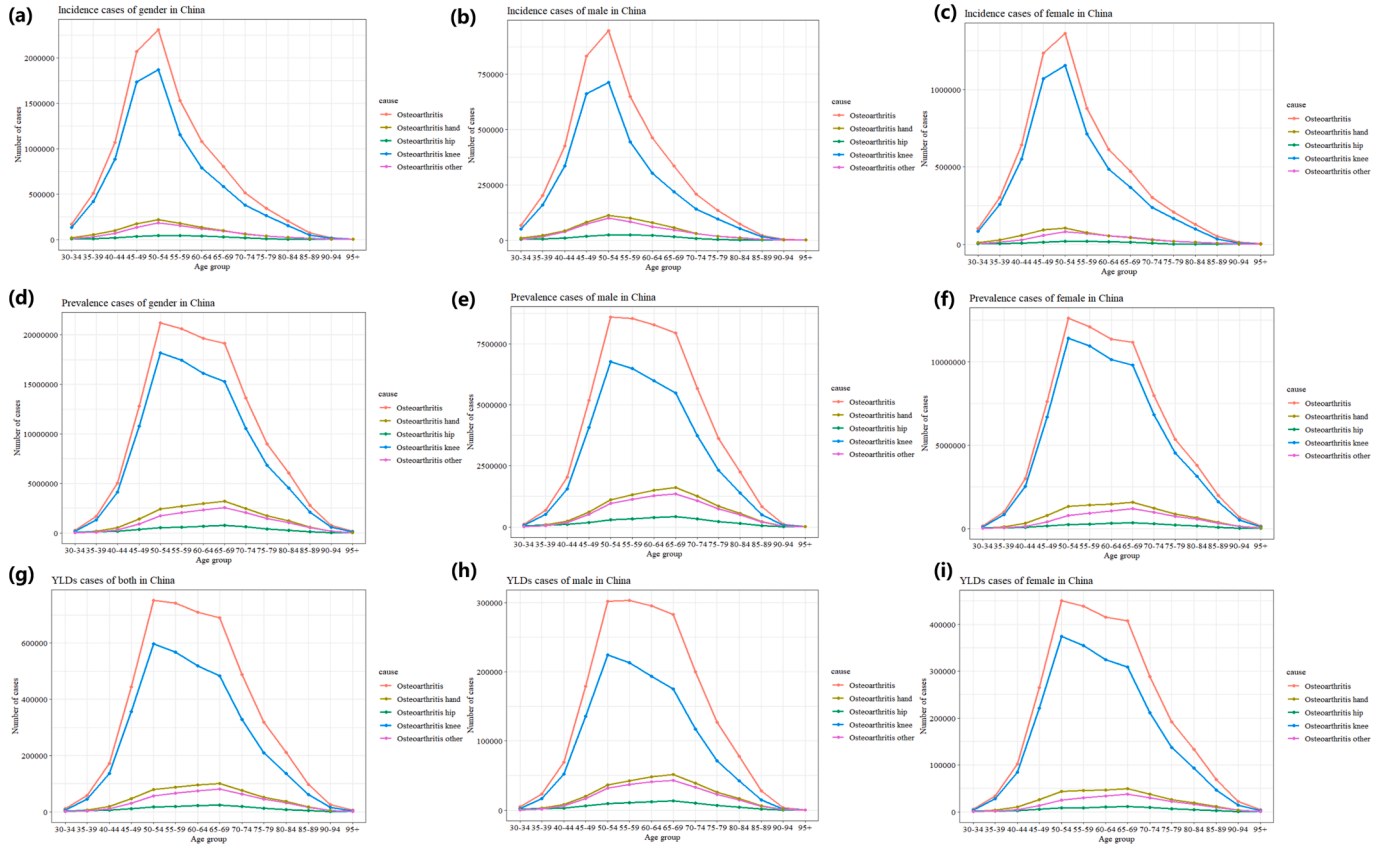

Fig. 2. Number of incident cases, prevalent cases, and YLDs of osteoarthritis (including hand, hip, knee, and other osteoarthritis) by gender (both genders, males, and females) and age group in China in 2019.

increased with age before the age of 50, regardless of gender. After the age of 40, the incidence rate showed a linear increase with age, consistent with findings by Kopec, Danhui Li, and others (Kopec et al., 2007; Balata et al., 2020). Another research indicated a close relationship between aging and osteoarthritis, with the condition being irreversible (Woolf and Pfleger, 2003). As individuals age, muscle mass and strength tend to decline, leading to musculoskeletal impairments (Butler-Browne et al., 2013). Additionally, studies by Loeser and others

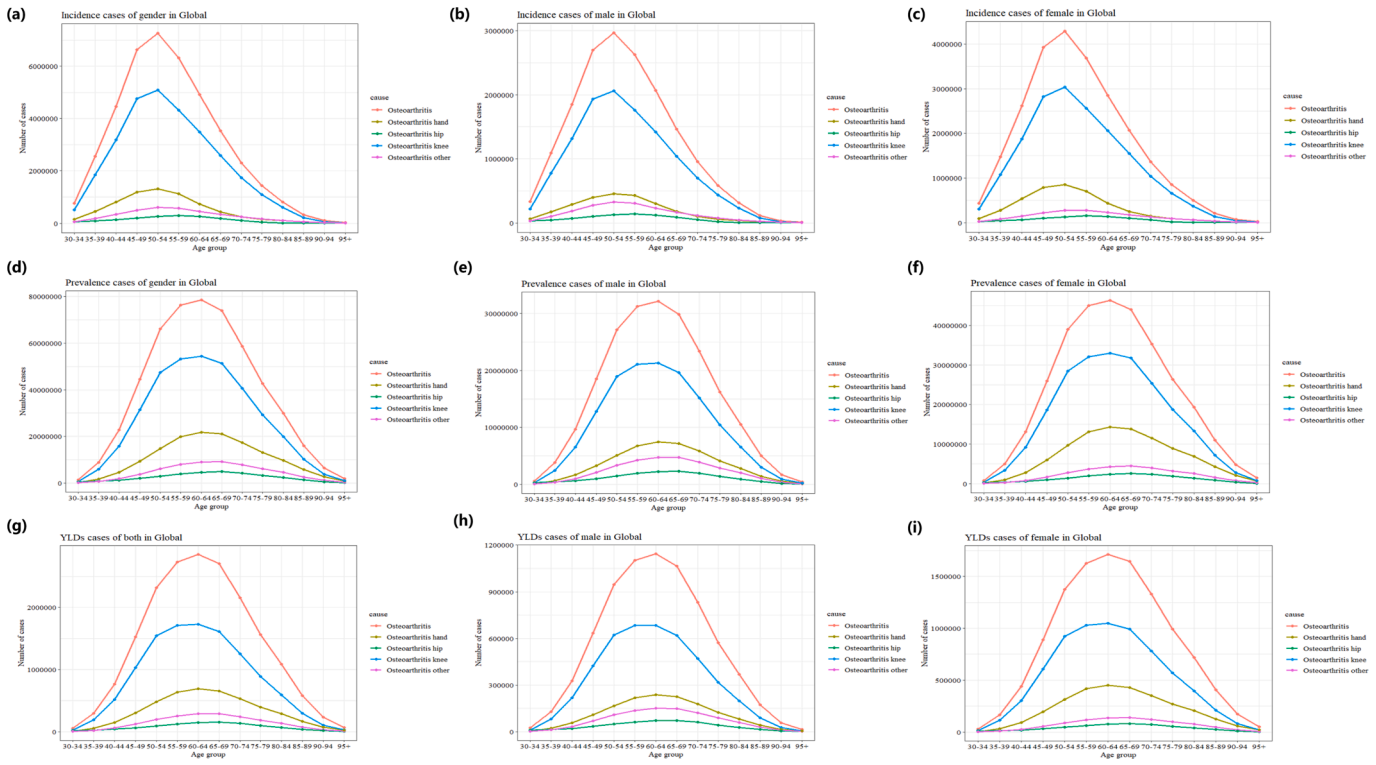

Fig. 3. Number of incident cases, prevalent cases, and YLDs of osteoarthritis (including hand, hip, knee, and other osteoarthritis) by gender (both genders, males, and females) and age group in Globally in 2019.

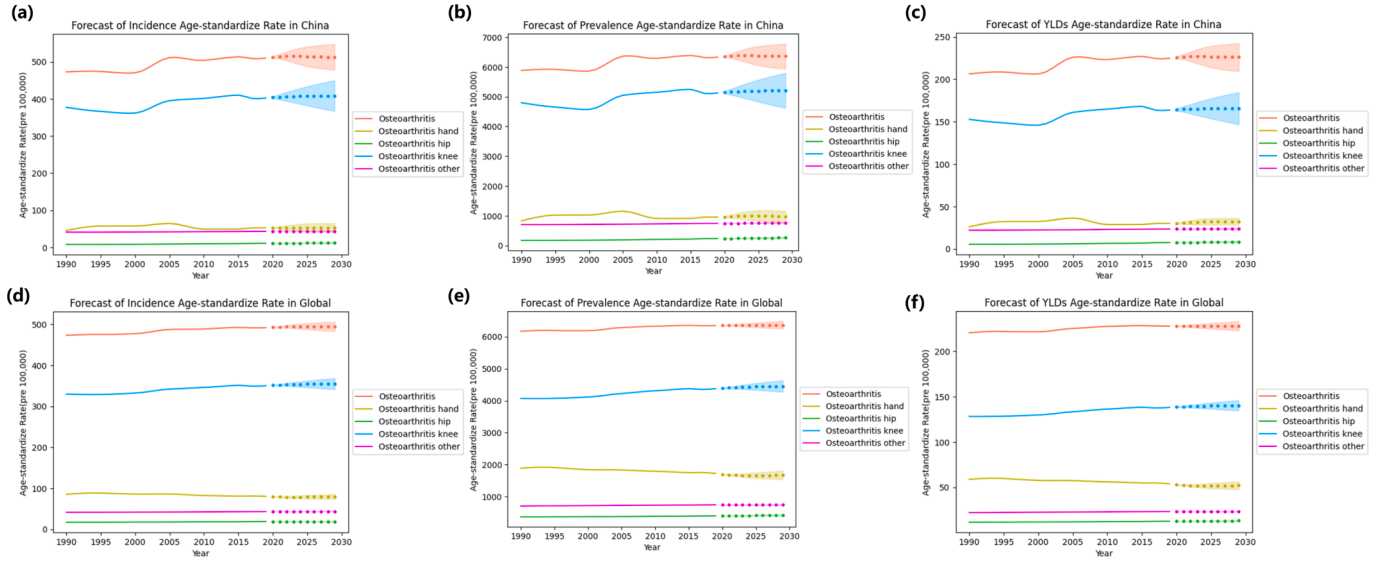

Fig. 4. Predicted trends in ASIR, ASPR, ASYR for osteoarthritis (including hand, hip, knee, and other osteoarthritis) in China and globally from 2020 to 2030.

(Loeser et al., 2016) suggest that aging is a major risk factor for osteoarthritis and is often associated with age-related inflammation, oxidative stress, and disruptions in energy metabolism, among other potential mechanisms. Considering the results of this study, it is essential to take proactive measures to address osteoarthritis. Establishing a comprehensive social security system for the aging population could alleviate the disease burden of knee osteoarthritis. This may involve promoting community-based management and self-care for osteoarthritis, building upon the foundation of primary healthcare services (Sun et al., 2019).

Our study results also indicated that the disease burden of osteoarthritis in females was higher than in males. osteoarthritis was more common in females, consistent with the findings of Safiri *et al.* (Safiri et al., 2020). According to relevant research, osteoarthritis presents differently in females and males, with females reporting more severe pain and higher disability rates (Debi et al., 2009). Additionally, females exhibit distinct patterns of cartilage degeneration, and their susceptibility to osteoarthritis is partially due to gender differences in cartilage health (Hanna et al., 2009). Therefore, the main reason osteoarthritis predominantly affects females could be the more severe disease manifestations (i.e., structural changes and clinical symptoms) and unique cartilage degeneration patterns in females compared to males. Additionally, females have wider pelvises, larger Q angles, and greater knee

valgus angles compared to males, leading to increased load on the lateral compartment of the knee joint and a higher risk of lateral compartment disease (Wei et al., 2019). This factor may also contribute to the higher burden of osteoarthritis in females compared to males.

Based on current research findings both domestically and internationally, osteoarthritis in the hip and knee joints is widespread and disabling (Katz et al., 2021). To address the increasing disease burden, primary and secondary prevention as well as early intervention might be more effective in reducing the burden (Bannuru et al., 2019). At the national policy level, it is advisable to enhance public awareness of the importance of a healthy lifestyle. This includes promoting widespread education about osteoarthritis, engaging in age-appropriate and scientifically sound physical activities, controlling body weight, maintaining a balanced diet, and ensuring workplace safety. At the individual level, it is recommended to enhance knowledge about osteoarthritis, understand its nature and treatments, practice self-care, prevent joint injuries, engage in regular physical activities, and manage body weight. Additionally, complementary medications such as nonsteroidal anti-inflammatory drugs and corticosteroid injections can be used alongside the fundamental treatments of education, exercise, and weight management. For patients with severe symptoms, total joint replacement surgery can effectively alleviate pain.

Our study filled gaps in comparative analyses of the disease burden of four different types of osteoarthritis in China and globally using GBD data, providing support for policymaking in disease prevention and treatment. However, we acknowledge several limitations in our research: Firstly, our data relied on the GBD database, which might have limitations in its research methods. The input data were restricted to available sources at the time of analysis, including both individual-level registration and hospitalization data with multiple ICD codes. This limitation could affect the accuracy of the results. Secondly, the 2019 GBD study's definition of osteoarthritis excluded symptoms and disabilities related to the spine. These symptoms and disabilities were categorized under "low back pain" or "neck pain," potentially underestimating the burden of osteoarthritis. In conclusion, osteoarthritis is prevalent worldwide and will continue to be a major public health issue in the future. Public awareness of modifiable risk factors and educational programs addressing disease prevention are crucial in mitigating the substantial burden of osteoarthritis.

5. Ethics approval and consent to participate

Patient informed consent has been waived by the Committee of Jinhua Guangfu Tumor Hospital [2023-044].

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Author contributions

Liping Wang conceived of the study, and participated in its design and interpretation and helped to draft the manuscript. Yitong Ye performed the statistical analysis and revised the manuscript critically. All the authors read and approved the final manuscript.

CRediT authorship contribution statement

Liping Wang: . **Yitong Ye:** Writing – original draft, Visualization, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2023.102562.

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