Heliyon 10 (2024) e35026

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Global years lived with disability for musculoskeletal disorders in adults 70 Years and older from 1990 to 2019, and projections to 2040

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ARTICLE INFO

Keywords:
Musculoskeletal disorders
Adults aged ≥ 70 years
Temporal trend
Years lived with disability

ABSTRACT

In this article, we provided a comprehensive overview and in-depth analysis of global patterns and temporal trends in years lived with disability (YLDs) for musculoskeletal (MSK) disorders in individuals aged ≥70. Data on YLDs for MSK disorders in individuals aged ≥70 were obtained from the Global Burden of Disease 2019. The average annual percentage change (AAPC) was calculated to assess the temporal trends in the YLDs rate of MSK disorders. A Bayesian Age-Period-Cohort model was used to predict the YLDs rate up to the year 2040. In 2019, the global rate of YLDs for MSK disorders in individuals aged ≥70 were 4819.81 (95 % UI: 3402.91 - 6550.77) per 100,000 persons. The YLDs rate of MSK disorders in female was 1.36 times higher than that in male, and was highest in high SDI regions. From 1990 to 2019, the global YLDs rate showed a slightly downward trend (AAPC = −0.04 %, 95 % CI: −0.06 % to −0.03 %), while it significantly increased in high, low-middle, low SDI regions. Tobacco and high body mass index were the primary risk factors worldwide, while in low SDI regions, occupational risks emerged as the predominant factors. Up to 2040, the global YLDs rate of MSK disorders are expected to increase by 1.78 %, with 36.39 %, 20.66 %, 18.96 % and 5.32 % growth in other MSK disorders, rheumatoid arthritis, neck pain and osteoarthritis. MSK disorders are a significant and continuously growing public health concern among older adults. Tailored interventions should be developed for older adults, taking into account the variations across distributions, trends, and risk factors in terms of sex and SDI levels.

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https://doi.org/10.1016/j.heliyon.2024.e35026
Received 8 February 2024; Received in revised form 13 July 2024; Accepted 22 July 2024
Available online 23 July 2024

1. Introduction

The physical and psychological damages including long-term pain, physical disability, psychological distress, caused by musculoskeletal (MSK) disorders significantly reduces people's quality of life [1]. Nowadays, MSK disorders including low back pain (LBP), osteoarthritis, neck pain (NP), rheumatoid arthritis (RA) and gout have become a prominent public health issue, causing significant harm to global public health and imposing a heavy economic burden [2]. Healthcare expenditures related to MSK disorders in the United States amounted to a staggering $380.9 billion [3], while the European region incurred a combined cost of €240 billion, encompassing healthcare expenses as well as productivity losses attributable to MSK disorders [4].

Based on the Global Burden of Diseases datasets, several studies have reported the burden and trends of global MSK disorders. From 1990 to 2019, although the age-standardized incidence/prevalence rates for global MSK disorders have decreased, the number of cases has still exhibited an increasing trend due to population growth [2,5]. Among the specific population, MSK disorders have become the third leading cause of global disability-adjusted life years (DALYs) among adolescents and young adults, reflecting a 21.2 % increase in DALYs [6]. Between 1990 and 2019, the global prevalence of MSK disorders in women of childbearing age showed increasing trends in 138 countries, decreasing trends in 24 countries, and relatively flat trends in 42 countries [7].

There are significant differences in age- and sex-specific burden and trends in MSK disorders. The prevalence of MSK disorders typically increases with age, with women having a higher prevalence than men [8]. Particularly significant is the fact that older adults are more susceptible to severe debilitation caused by MSK disorders, leading to reduced mobility and independence [9]. In both developed and underdeveloped countries, MSK disorders are prevalent among the elderly population, potentially impacting their physical function and well-being [10,11]. A cross-sectional study in Bangladesh showed that most older people with MSK experienced musculoskeletal pain, back pain, and limited mobility [12]. The prevalence of skeletal muscle pain in older populations in nursing homes is 30.20 % (95%CI: 29.90–30.50 %) [13]. For both sexes, the prevalence of back pain is highest in the 80–90 age group, while the prevalence of neck pain and rheumatoid arthritis is highest in the 70–80 age group [14].

Being the primary cause of years lived with disability (YLDs) in the global elderly population [15], are there disparities in the disease burden, trends, geographic distribution, and risk factors of MSK disorders among the elderly population? There still exists a substantial gap in comprehensive research providing detailed insights into MSK disorders in the elderly population at the global, regional, and national levels. Moreover, the future changing trends in these aspects remain to be investigated. In this study, we aimed to provide a comprehensive overview and in-depth analysis of global patterns and temporal trends in YLDs for MSK disorders in individuals aged ≥70. Based on a comprehensive understanding of the current situation, we have further predicted the future trends of MSK disorders to 2040 to assist in proactive planning and addressing the challenges associated with MSK disorders.

2. Materials and methods

2.1. Data sources

We obtained data on the global YLDs for total MSK disorders and the six specific causes (LBP, osteoarthritis, NP, RA, gout and other MSK disorders) in adults aged ≥70 years from the GBD 2019 (https://vizhub.healthdata.org/gbd-results/). Based on large amount of health-related data collected globally and various stable and reliable models to estimate the burden of disease, GBD 2019 provided comprehensive and standardized health assessments of 369 diseases and injuries [16], and 87 risk factors in 204 countries and territories during 1990–2019 [17]. The measures including incidence, mortality, disability life adjusted years, YLDs, years of life lost were used to describe the burden of diseases. The data on the burden of diseases in GBD 2019 were further categorized by age, sex, geographic location and Socio-demographic Index (SDI) levels to compare differences in disease burden among populations.

From GBD 2019, we extracted the annual number and rate of YLDs for MSK disorders in adults aged ≥70 years from 1990 to 2019, stratified by sex, location, and SDI. The data for adults adults aged ≥70 years was obtained by selecting the "70+ years" option within the age group on the 'vizhub.healthdata' platform. The International Classification of Diseases version 10 codes are used to define these MSK disorders and details on definitions and modelling strategies for data estimation are available in GBD 2019 study [7,16]. The 204 countries and territories are divided into five SDI quintiles (high, high-middle, middle, low-middle, low) based on the SDI scores [18].

3. Statistical analysis

3.1. Join-point regression model analysis

We used join-point regression model to calculate average annual percent change (AAPC) and its 95 % confidence interval (CI) to describe the trends of YLDs rate [19]. The join-point regression model is usually used to analyze trend changes in time series data by fitting data into one or more linear segments. The slopes of each segment (*b*) can be used to calculate annual percent change (APC, APC $= \{\exp(b) - 1\} \times 100$), representing the rate of change for that segment. The AAPC is a summary measure of the trend over a pre-specified fixed interval, which computed as a weighted average of the APCs from the join-point model, with the weights equal to the length of the APC interval [20]. A statistical test's p-value greater than 0.05 signifies an insignificant trend for AAPC. Furthermore, an AAPC greater than 0 with a statistical test's p-value less than 0.05 indicates an increasing trend, whereas an AAPC less than 0 with a statistical test's p-value less than 0.05 indicates a decreasing trend.

3.2. Bayesian Age-Period-Cohort model (BAPC)

We applied the BAPC model based on the integrated nested Laplace approximations (INLA) algorithm to predict YLDs rate to 2040. The BAPC model is based on the Age-Period-cohort (APC) model, which can be understood as a log-linear Poisson model. The formula is as follow:

$$\log(Y_{ij}) = \mu + \alpha_i + \beta_j + \gamma_c.$$

Yij represents the YLDs rate in age group i at time period j; μ denotes the intercept, α_i represents age effect; β_j represents period effect; γ_c represents cohort effect. Considering the smoothing assumption, the BAPC model assumes a second-order random walk (RW2) for the prior distribution of age, period, and cohort effects. That is, the BAPC model assumes the RW2 prior distribution of the age effect as follows [21,22]:

$$f\left(\alpha \middle| k_\alpha \propto k_\alpha^{\frac{t-2}{2}} \exp\left\{ -\frac{k_\alpha}{2}\sum_{i=3}^{I}[(\alpha_i - \alpha_{i-1}) - (\alpha_{i-1} - \alpha_{i-2})]^2 \right\}\right.$$

Due to we are interested in the YLDs rate of age group i in the future t period, an independent random effect $Z_{i,j+t} \sim N(0,k_z^{-1})$ is added to the model, the formula is as follows [17–20]:

$$\log(Y_{i,j+t}) = \mu + \alpha_i + \beta_{j+t} + \gamma_{c+t} + Z_{i,j+t}$$

Therefore, we need to extrapolate the period and cohort effects based on the structure of the RW2 model, specifically, in the BAPC model, period effects in the j+1 period will have the following distribution of conditions:

$$\beta_{j+t} \middle| \beta_1, \ldots, \beta_j, k_\beta \sim N\left((1+t)\beta_j - t\beta_{j-1}, k_\beta^{-1}(1+2^2+\ldots+t^2)\right)$$

We selected global data on MSK disorders as well as LBP, osteoarthritis, NP, RA, gout, and other MSK disorders. The data were divided into a training set (data from 1990 to 2012) and a test set (data from 2013 to 2019) to test the performance and accuracy of the

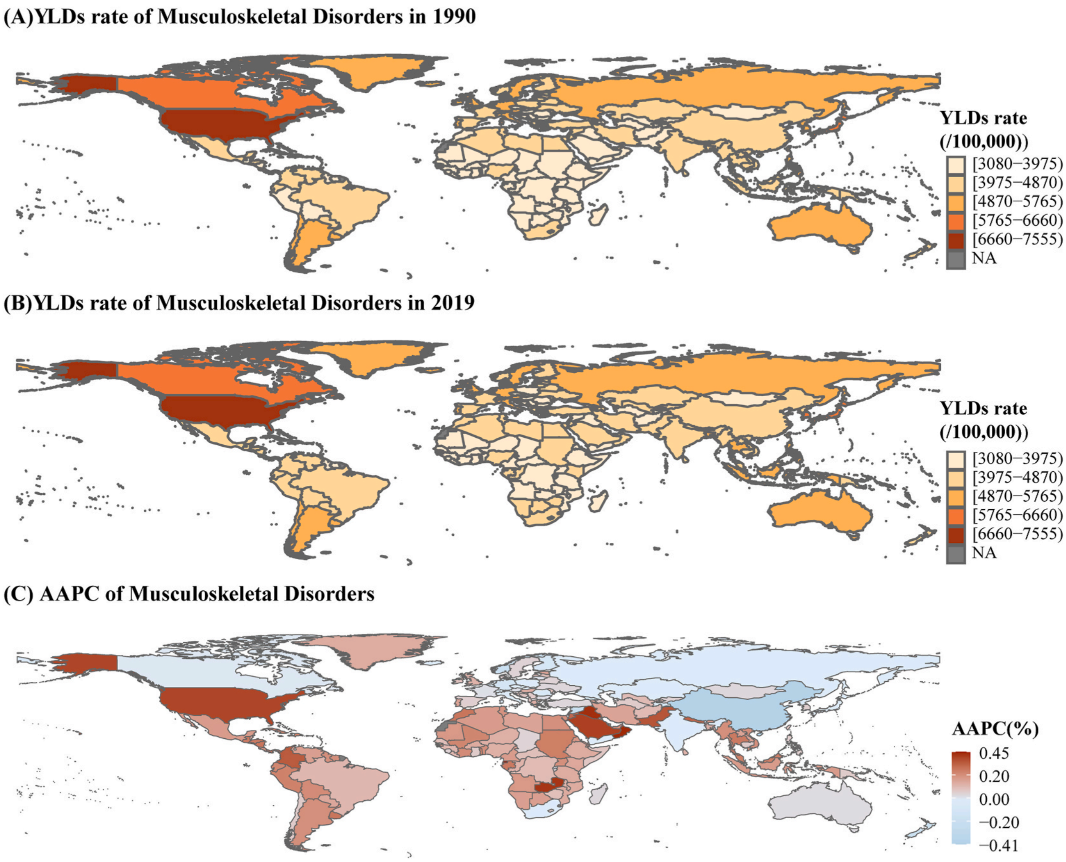

Fig. 1. Global YLDs for Musculoskeletal Disorders in Adults 70 Years and Older among 204 Countries and Territories. (A) YLDs rate in 1990; (B) YLDs rate in 2019; (C) AAPCs of YLDs from 1990 to 2019.

prediction model. The prediction results of BAPC model were compared with those of smooth spline model, ARIMA model, and joinpoint regression model. The absolute percentage deviation (APD) was used to evaluate the performance of the model. APD calculating formula for $|(\hat{X} - X)/X * 100|$, where $\hat{X}$ denotes the predictive value and X denotes the observational value. The mean APDs of our selected prediction model are shown in the Supplementary Materials 1. Because of the relatively lower mean APDs for the BAPC model, we used it to predict YLDs rates through 2040 for MSK disorders.

3.3. Software

We employed Joinpoint (version 4.8.0.1) for joint-joint regression model analysis and the BAPC package within the R software (version 4.2.1) for the Bayesian age-period-cohort model.

4. Results

4.1. Global, SDI, and regional YLDs for MSK disorders in adults 70 Years and older

Globally, in 2019, the YLDs rate in adults aged ≥70 years was 4819.81 (95 % UI: 3402.91 - 6550.77) per 100,000 persons, which was decreased 1.30 % compared to 1990 (Fig. 1A and B). In different SDI regions, the high SDI region had the highest YLDs rate in 2019, which was (5964.51, 95 % UI: 4195.24–8160.09) per 100,000 persons. Regionally, countries in High-income North America, High-income Asia Pacific, Australasia, Western Europe and Southern Latin America Asia had higher YLDs rate (Table 1 and Fig. 1B). The global total number of YLDs for MSK disorders was 22,348,256 (95 % UI: 15,778,424 - 30,374,259) in 2019, which was increased by 127.06 % compared to 1990 (Table 1). The highest number of YLDs for MSK disorders was reported in the High SDI region. East Asia had the highest number of YLDs for MSK disorders. Both the total number and rate of YLDs in female were significantly higher than that in male.

5. YLDs for six specific causes involved in MSK disorders in adults 70 Years and older

As for six causes involved in MSK disorders (Supplementary Materials 2–7), low back pain, osteoarthritis and NP were most common causes of YLDs reported in adults aged ≥70 years. Among these three diseases, the high SDI region has the highest YLDs rate, with 2512.72 (95 % UI: 1760.33–3351.36) per 100,000 persons, 1652.12 (95 % UI: 848.9–3333.38) per 100,000 persons and 621.51 (95 % UI: 391.72–932.08) per 100,000 persons, respectively (Supplementary Materials 2–4). The Oceania (2560.67, 95 % UI: 1803.45–3481.46) per 100,000 persons reported highest YLDs rate for low back pain. High-income North America reported highest YLDs rate for both osteoarthritis (1893.62, 95 % UI: 976.25–3778.91) per 100,000 persons and NP (899.28, 95 % UI: 580.73–1317.89) per 100,000 persons (Supplementary Materials 2–4).

5.1. Trends of YLDs for MSK disorders in adults 70 Years and older from 1990 to 2019

From 1990 to 2019, the global YLDs rate of MSK disorders in adults aged ≥70 years slightly decreased (AAPC = −0.04 %, 95 % CI: −0.06 % to −0.03 %, $P < 0.05$), with 172 countries presenting increasing trends, 17 presenting decreasing trends and 15 presenting stable trends (Table 1 and Fig. 1C). High SDI (0.14 %, 95 % CI: 0.09 %–0.18 %, $P < 0.05$), low-middle SDI (0.09 %, 95 % CI: 0.06 %–0.11 %, $P < 0.05$) and low SDI (0.14 %, 95 % CI: 0.12 %–0.15 %, $P < 0.05$) showing significant increasing trend. LBP (−0.51 %, 95 % CI: −0.53 % to −0.5 %, $P < 0.05$) and NP (−0.04 %, 95 % CI: −0.07 % to −0.02 %, $P < 0.05$) presenting decreasing trends. Osteoarthritis (0.07 %, 95 % CI: 0.05 %–0.09 %, $P < 0.05$), RA (0.17 %, 95 % CI: 0.15 %–0.2 %, $P < 0.05$), gout (0.86 %, 95 % CI: 0.74 %–0.98 %, $P < 0.05$) and other MSK disorders (1.2 %, 95 % CI: 1.13 %–1.27 %, $P < 0.05$) presenting increasing trends (Table 1).

5.2. The Relationships Between YLDs for MSK disorders and SDI scores

Significant positive correlations were observed between YLDs rate of MSK disorders in adults aged ≥70 years and SDI scores in 2019 ($R = 0.55$, $P < 0.05$) (Fig. 2A). Those positive correlations were also found in each specific cause (Supplementary Materials 8). When stratified according to risk factors, significant positive correlations were also observed between YLDs rate of MSK disorders attributed to tobacco ($R = 0.44$, $P < 0.05$) (Fig. 2B), high body-mass index (BMI) ($R = 0.78$, $P < 0.05$) (Fig. 2C) and kidney dysfunction ($R = 0.47$, $P < 0.05$) (Fig. 2E), and SDI scores. It was negative correlation between YLDs rate of MSK disorders attributed to occupational risks and SDI scores ($R = -0.76$ $P < 0.05$) (Fig. 2D).

5.3. Contribution of Risk Factors to YLDs for MSK disorders in adults 70 Years and older

In most countries, high BMI was the leading risk factor contributed to MSK disorders in adults aged ≥70 years in 2019 (Supplementary Materials 9). However, there were differences in the composition of risk factors among males and females, as well as different levels of SDI. For the female, high BMI (50.58 %) was leading risk factor, while tobacco (50.64 %) was leading risk factor for the male. In the high, high-middle and middle SDI, tobacco and high BMI were still leading risk factors. However, occupational risks were ranked first (51.58 %) and second (35.84 %) in the low and low-middle SDI (Fig. 3).

Table 1
The Number and Rate of YLDs for Musculoskeletal Disorders in Adults 70 years and older in 1990 and 2019 with AAPCs over the 30 years.

Characteristics	Number of YLDs in 1990	Rate of YLDs in 1990 per 100,000 persons)	Number of YLDs in 2019	Rate of YLDs in 2019 (per 100,000 persons)	AAPC (%, 95 % CI)
Global	9842136 (6905739–13306159)	4883.31 (3426.37–6602.03)	22348256 (15778424–30374259)	4819.81 (3402.91–6550.77)	−0.04 (−0.06 to −0.03)*
Sex					
Female	6512040 (4583551–8827860)	5457.88 (3841.57–7398.81)	14220524 (10061696–19260834)	5463.95 (3866–7400.59)	0.0036 (−0.0062 to 0.0135)
Male	3330096 (2329272–4507405)	4049.64 (2832.56–5481.33)	8127732 (5708504–11118752)	3995.66 (2806.35–5466.07)	−0.0472 (−0.0961 to 0.0017)
Causes					
Low back pain	4852370 (3417820–6628432)	2407.57 (1695.8–3288.78)	9607643 (6721462–13036623)	2072.06 (1449.61–2811.59)	−0.51 (−0.53 to −0.5)*
Rheumatoid arthritis	194915 (136002–259546)	96.71 (67.48–128.78)	471603 (329377–629545)	101.71 (71.04–135.77)	0.17 (0.15–0.2)*
Neck pain	1120177 (668572–1768703)	555.79 (331.72–877.57)	2545834 (1542920–3973074)	549.06 (332.76–856.87)	−0.04 (−0.07 to −0.02)*
Osteoarthritis	2423689 (1241468–4912282)	1202.55 (615.97–2437.29)	5693307 (2910153–11611987)	1227.87 (627.63–2504.34)	0.07 (0.05–0.09)*
Gout	154201 (89955–227015)	76.51 (44.63–112.64)	453078 (271255–660926)	97.71 (58.5–142.54)	0.86 (0.74–0.98)*
Other musculoskeletal disorders	1096785 (596417–1795196)	544.18 (295.92–890.71)	3576791 (2138145–5493009)	771.4 (461.13–1184.67)	1.2 (1.13–1.27)*
SDI rank					
High SDI	3791515 (2656914–5220240)	5757.32 (4034.46–7926.81)	7654648 (5384026–10472375)	5964.51 (4195.24–8160.09)	0.14 (0.09–0.18)*
High-middle SDI	2595555 (1829008–3551268)	4678.9 (3297.08–6401.72)	5394792 (3792670–7377420)	4534.54 (3187.89–6201.02)	−0.11 (−0.15 to −0.07)*
Middle SDI	2031842 (1431743–2725340)	4491.45 (3164.91–6024.45)	5474119 (3852100–7384064)	4367.66 (3073.49–5891.56)	−0.1 (−0.17 to −0.04)*
Low-middle SDI	1056104 (744766–1415609)	4187.73 (2953.19–5613.26)	2933268 (2045789–3907385)	4297.05 (2996.95–5724.07)	0.09 (0.06–0.11)*
Low SDI	362589 (251094–492678)	3756.98 (2601.72–5104.9)	881366 (612300–1191539)	3910.74 (2716.85–5287.01)	0.14 (0.12–0.15)*
GDB regions					
Southeast Asia, east Asia, and Oceania					
Southeast Asia	490366 (351094–654742)	4487.51 (3212.98–5991.77)	1327753 (948935–1774343)	4780.21 (3416.38–6388.03)	0.22 (0.21–0.22)*
East Asia	1859476 (1305304–2520592)	4692.78 (3294.21–6361.24)	4712385 (3286439–6475436)	4206.76 (2933.82–5780.65)	−0.39 (−0.49 to −0.29)*
Oceania	4865 (3462–6560)	4474.31 (3184.55–6033.4)	11861 (8497–15964)	4578.51 (3279.87–6162.37)	0.08 (0.07–0.09)*
Sub-Saharan Africa					
Western Sub-Saharan Africa	149238 (102693–206998)	3747.37 (2578.62–5197.71)	304521 (209146–419470)	3887.28 (2669.79–5354.63)	0.12 (0.11–0.14)*
Central Sub-Saharan Africa	31267 (21388–43341)	3736.55 (2555.97–5179.45)	76024 (52324–103994)	3895.98 (2681.45–5329.35)	0.14 (0.14–0.15)*
Southern Sub-Saharan Africa	53520 (37025–73878)	4022.21 (2782.54–5552.18)	107966 (74110–149512)	4072.17 (2795.21–5639.17)	0.05 (0.03–0.06)*
Eastern Sub-Saharan Africa	111405 (76595–154647)	3537.21 (2431.97–4910.17)	252428 (172481–349564)	3712.7 (2536.84–5141.36)	0.16 (0.15–0.18)*
South Asia	908763 (642633–1213647)	4149.89 (2934.59–5542.14)	2951828 (2077059–3943436)	4270.33 (3004.82–5704.86)	0.09 (0.06–0.12)*
Latin America and Caribbean					
Tropical Latin America	187365 (130494–252884)	4310.92 (3002.42–5818.38)	600491 (415956–812124)	4488.45 (3109.12–6070.33)	0.14 (0.13–0.14)*
Caribbean	51282 (35188–71201)	3441.16 (2361.21–4777.79)	112542 (77006–155937)	3651.46 (2498.46–5059.41)	0.2 (0.16–0.23)*
Andean Latin America	39472 (27233–54246)	3866.71 (2667.74–5314.01)	130800 (90327–181279)	4162.51 (2874.53–5768.93)	0.25 (0.24–0.27)*
Central Latin America	171240 (118435–235156)	4212.51 (2913.5–5784.86)	589302 (407207–807528)	4524.09 (3126.14–6199.42)	0.24 (0.2–0.28)*
North Africa and Middle East	309520 (217989–418923)	4136.97 (2913.58–5599.22)	861171 (603871–1160195)	4412.21 (3093.94–5944.27)	0.23 (0.2–0.25)*
Central Europe, eastern Europe, and central Asia					
Central Europe	298930 (207711–410854)	3809.52 (2647.03–5235.85)	535701 (372671–738137)	3832.12 (2665.89–5280.25)	0.02 (0.01–0.03)*

(*continued on next page*)

Table 1 (*continued*)

Characteristics	Number of YLDs in 1990	Rate of YLDs in 1990 per 100,000 persons)	Number of YLDs in 2019	Rate of YLDs in 2019 (per 100,000 persons)	AAPC (%, 95 % CI)
Central Asia	88886 (61282–122161)	3994.92 (2754.28–5490.46)	113479 (78842–156133)	4051.31 (2814.73–5574.08)	0.05 (0.04–0.06) *
Eastern Europe	745951 (512369–1050556)	4925.21 (3382.96–6936.39)	1023721 (706404–1442583)	5003.22 (3452.4–7050.32)	0.05 (0.03–0.07) *
High-income regions					
High-income North America	1564674 (1101849–2130762)	6699.74 (4717.98–9123.66)	2987408 (2130190–3996901)	7384.43 (5265.52–9879.75)	0.34 (0.3–0.39)*
High-income Asia Pacific	670339 (463065–925242)	5950.82 (4110.78–8213.68)	1953711 (1350721–2731088)	5876.13 (4062.53–8214.23)	−0.04 (−0.09 to 0.01)
Australasia	76869 (53165–106482)	5274.59 (3648.05–7306.57)	175382 (122255–246064)	5287.07 (3685.49–7417.83)	0.01 (−0.01 to 0.04)
Western Europe	1886837 (1316317–2603737)	5050.46 (3523.36–6969.37)	3220398 (2233045–4491763)	5061.9 (3509.95–7060.26)	0.01 (0–0.02)*
Southern Latin America	141871 (97880–196347)	5393.01 (3720.74–7463.8)	299383 (206696–414968)	5722.92 (3951.14–7932.41)	0.21 (0.18–0.23) *

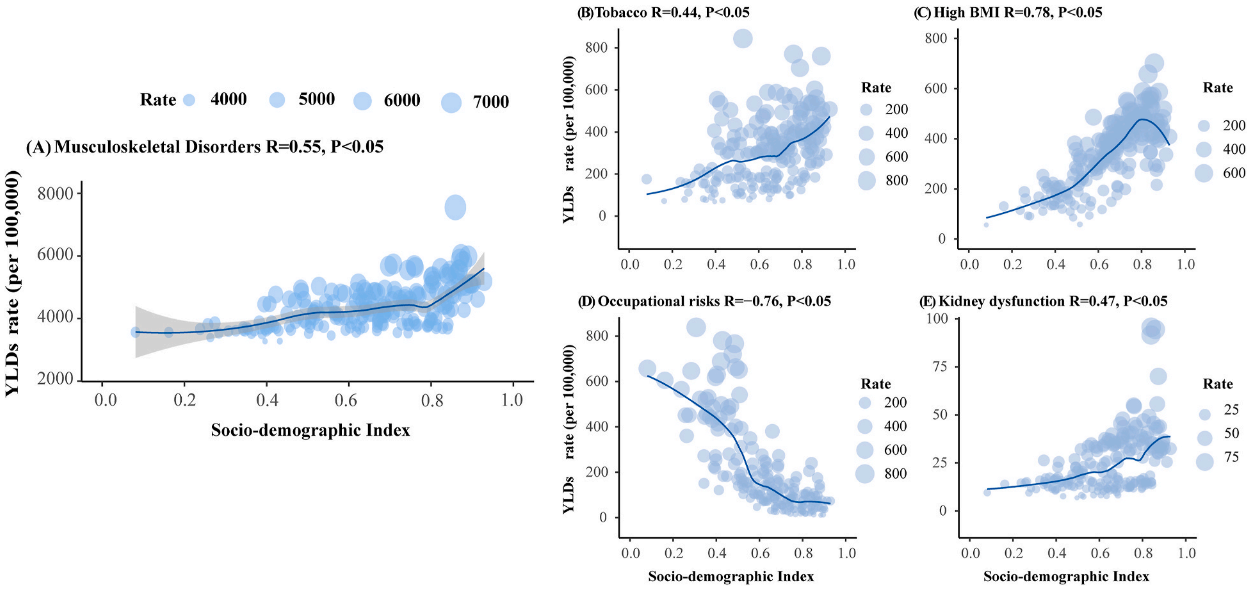

Fig. 2. The Relationships Between YLDs rate of MSK disorders and SDI Scores. (A) Relationships between YLDs rate of MSK disorders and SDI scores; (B) Relationships between YLDs rate of MSK disorders attributed to tobacco and SDI scores; (C) Relationships between YLDs rate of MSK disorders attributed to high BMI and SDI scores; (D) Relationships between YLDs rate of MSK disorders attributed to occupational risks and SDI scores; (E) Relationships between YLDs rate of MSK disorders attributed to kidney dysfunction and SDI scores.

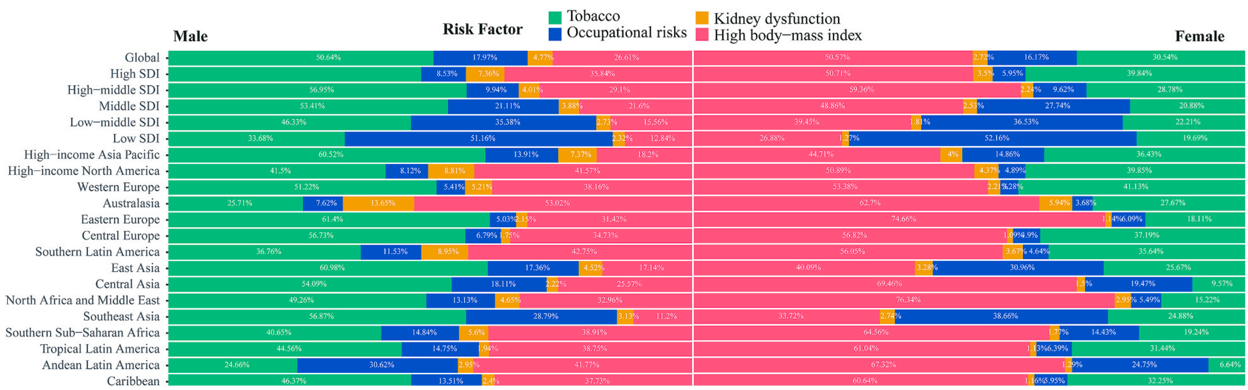

Fig. 3. Contribution of risk factors to YLDs for MSK disorders in adults 70 Years and older.

5.4. The Projections of YLDs of MSK disorders in adults 70 Years and older to 2040

Between 2020 and 2040, the global YLDs rate of MSK disorders in adults aged ≥70 years is expected to increase by 1.78 %, from 4819.81 (95 % UI: 3402.91 - 6550.77) per 100,000 persons to 4905.77 (95 % UI: 3086.66 - 6724.88) per 100,000 persons (Fig. 4A). In 2040, except for high SDI regions, YLDs rates in other SDI regions are increasing. (Supplementary Materials 10). Regarding six specific causes, it is expected that the global YLDs rate of other MSK disorders, RA, NP, and osteoarthritis will increase by 36.39 %, 20.66 %, 18.96 %, and 5.32 % respectively. On the other hand, LBP and gout are expected to decrease by 13.83 % and 13.26 % respectively (Fig. 4B–G).

6. Discussion

Through a comprehensive analysis of MSK disorders in adults aged ≥70 years over the past 30 years, we found that the burden of MSK disorders in this age group is very high, resulting in a high YLDs. They particularly impose a significant burden on females and in high SDI regions. LBP, osteoarthritis, and NP are predominant types of MSK disorders. From 1990 to 2019, the YLDs rate of MSK disorders showed a significant upward trend in the high, low-middle, and low SDI regions. As for specific causes, YLDs rate of osteoarthritis, RA, gout, and other MSK disorders showed a clear upward trend. From a global perspective, tobacco and high BMI emerged as the primary risk factors for YLDs in adults aged ≥70 years, but they exhibit distinct distribution patterns. Tobacco was identified as the leading risk factor among males, whereas high BMI was the leading risk factor among females. Furthermore, in low and low-middle SDI regions, occupational risks played a significant role in contributing to MSK disorders. The YLDs rate of MSK disorders is projected to increase to 4905.77 per 100,000 persons by 2040. This increase is particularly notable for other MSK disorders, RA, NP, and osteoarthritis.

Our study revealed significant variations in the YLDs rates for MSK disorders among adults aged ≥70 years. These variations were observed in terms of distribution, trends, and risk factors by sex and SDI levels. The YLDs rate in females was significantly higher than that in males. This finding has been previously reported and is believed to potentially be associated with sex hormones [23]. For instance, lower concentrations of estradiol in women have been identified as a risk factor for knee osteoarthritis, while lower concentrations of androstanedione have been associated with an increased risk of hip osteoarthritis [24]. After menopause, the decline in estrogen and androgen levels results in a lower incidence of osteoarthritis in women compared to men under 50 years of age. However, in individuals over 50 years of age, women have a higher incidence of osteoarthritis compared to men [25]. Therefore, prevention and control measures for the MSK disorders in female are particularly important. The YLDs rate showed a significant positive association with SDI scores across 204 countries and territories. Variations in risk factors, diagnosis and management may lead to differences patterns across SDI levels [8]. Individuals living in regions with a high SDI tend to prioritize their physical well-being. This increased awareness consequently enhances the willingness of patients with MSK disorders to actively seek medical treatment [26]. Simultaneously, due to the higher life expectancy of populations in high SDI regions and the significant impact of MSK disorders on healthy life years, it results in the highest rates of YLDs rate in these high SDI regions [27,28].

While there is a declining trend in the YLDs rate of LBP among adults aged ≥70 years, it is projected to remain a prevalent type of MSK disorders in the coming two decades. Additionally, despite the declining rate, the growing population continues to contribute to a steady increase in the number of YLDs cases. These observations are consistent with the latest research findings [29]. Osteoarthritis, RA, and other MSK disorders are anticipated to contribute significantly to the growing burden of YLDs. The older adults would

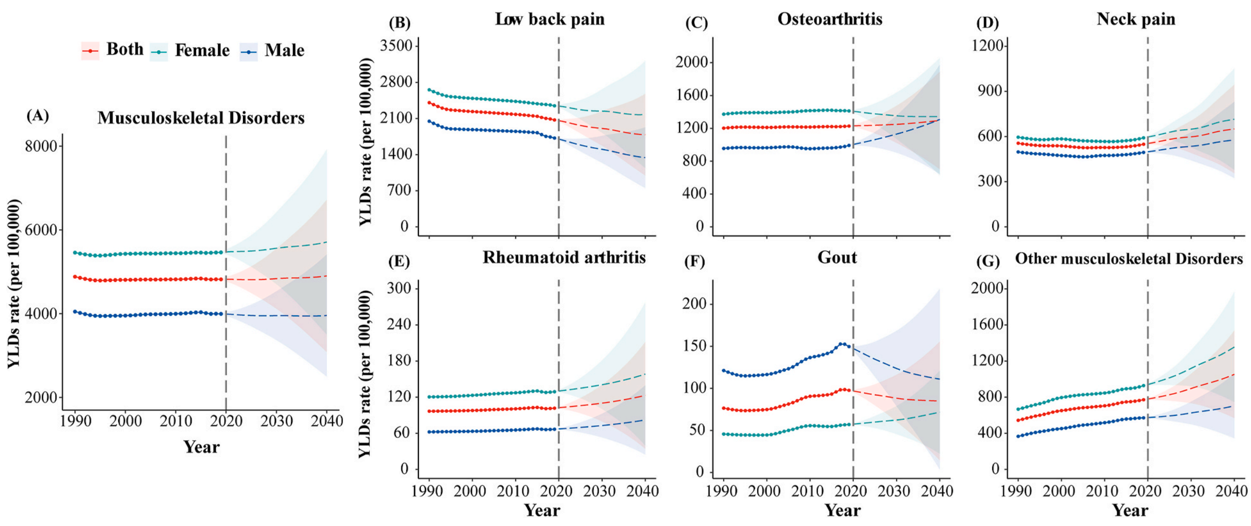

Fig. 4. The Projections of YLDs for MSK Disorders in Adults 70 Years and Older to 2040. (A) MSK disorders; (B) Low back pain; (C) Osteoarthritis; (D) NP; (E) RA; (F) Other MSK disorders.

represent 16 % of the global population by 2050 [30], and adults aged ≥70 years being the fastest growing segment in many countries [31,32].

MSK disorders also have a substantial impact on healthy life expectancy. In Japan, the eradication of arthrosis, low back pain, and their combination moderately increased the expected years without activity limitation (0.3–1.5 years) and decreased the years with activity limitation (0.3–1.5 years), more efforts are needed to address MSK disorders in the elderly population [33]. Nowadays, effectively preventing and controlling MSK disorders in the elderly population will pose a significant challenge. It requires targeted and specific investments and management in resources, technology, and policies. This includes strengthening the control of risk factors, establishing clear diagnostic criteria, developing appropriate treatment approaches, and reducing healthcare costs associated with the diagnosis and treatment of MSK disorders among the older population. These measures are necessary to address the unique needs and challenges faced by older individuals in managing MSK disorders [34,35].

Tobacco and high BMI were the primary risk factors for YLDs for MSK disorders among adults aged ≥70 years. Previous studies have indicated a correlation between tobacco and MSK disorders, particularly among ex-smokers and suggested that this correlation may be attributed to pharmacological effects of tobacco; or individuals with a lower pain and disability threshold are more inclined to initiate and sustain smoking habits [36]. Overweight or obesity can exert increased pressure on load-bearing joints, including the ankles, knees, and hips. This additional pressure can make these joints more susceptible to MSK disorders [37]. Therefore, it is crucial for older adults to maintain a healthy lifestyle, which includes reducing smoking, maintaining an optimal weight, and engaging in regular exercise. These practices are essential for the prevention and control of MSK disorders in this population [38,39]. However, occupational risks have been identified as the primary risk factors for MSK disorders in low SDI regions. Previous evidence suggests that effective interventions in the workplace, such as implementing workplace-based resistance training exercises and incorporating work breaks, can significantly reduce work-related MSK disorders [40,41]. Efforts need to be done to encourage and promote the improvement of working environments and equipment, and protective facilities to tackle the MSK disorders attributed to occupational risks, especially in the low SDI regions [42].

7. Limitations

Our study has several limitations. Firstly, other MSK disorders constitute a significant proportion of the total YLDs for MSK disorders among the elderly. However, there is currently no specific categorization for these “other MSK disorders”. Future research could focus on this category to provide a more comprehensive understanding of the global burden of MSK disorders among the elderly. Secondly, due to the unavailability of specific risk factor data for each individual MSK disorder, we were unable to conduct a comprehensive analysis of risk factors for each specific cause. Thirdly, our projections have not accounted for the impact of COVID-19 on YLDs of MSK disorders, which may introduce some biases.

8. Conclusion

As the leading cause of YLDs among adults aged ≥70 years, MSK disorders are becoming a growing public health concern, especially in female and high SDI regions. This issue requires global attention and an effective response. While there has been a slight decline in the YLDs rate of MSK disorders over the past three decades, the actual number of MSK disorder cases has significantly increased by 127 %, primarily due to population growth and the rising number of older individuals. In the next two decades, the YLDs rate of MSK disorders is projected to remain relatively stable. However, there is an expected increase in the global YLDs rates of other MSK disorders, RA, NP, and osteoarthritis. The primary risk factors associated with YLDs for MSK disorders among adults aged ≥70 years are tobacco and high BMI. However, in low SDI regions, occupational risks emerge as the most significant contributors to MSK disorders. It is crucial to develop targeted interventions that address these different risk factors to effectively tackle the burden of MSK disorders.

List of Abbreviation

Abbreviation	Definition
YLDs	Years Lived with Disability
MSK	Musculoskeletal
AAPC	the Average Annual Percentage Change
LBP	Low Back Pain
NP	Neck Pain
RA	Rheumatoid Arthritis
UI	Uncertain Interval
DALYs	Disability-Adjusted Life Years
GBD	Global Burden of Disease
SDI	Socio-Demographic Index
CI	Confidence Interval
APC	Annual Percentage Change
BAPC	Bayesian Age-Period-Cohort model
INLA	Integrated Nested Laplace Approximations
RW2	Second-order Random Walk
APD	the Absolute Percentage Deviation
BMI	Body Mass Index

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Patient and public involvement statement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

Funding

This study was supported by grants from the National Natural Science Foundation of China (Grant Numbers: U23A20496, 82173577, 81672005); the Mega-Project of National Science and Technology for the 13th Five-Year Plan of China (Grant Numbers: 2018ZX10715-014-002), and the China Postdoctoral Science Foundation (2023M742987).

CRediT authorship contribution statement

Can Chen: Writing – original draft, Visualization, Software, Methodology, Formal analysis, Data curation. **Yuxia Du:** Visualization, Methodology, Formal analysis, Data curation. **Kexin Cao:** Visualization, Formal analysis, Data curation. **Yue You:** Visualization, Data curation. **Lucheng Pi:** Methodology, Data curation. **Daixi Jiang:** Validation, Data curation. **Mengya Yang:** Formal analysis, Data curation. **Xiaoyue Wu:** Validation, Data curation. **Mengsha Chen:** Visualization, Data curation. **Wenkai Zhou:** Validation, Data curation. **Jiaxing Qi:** Validation, Data curation. **Dingmo Chen:** Data curation. **Rui Yan:** Data curation. **Changtai Zhu:** Writing – review & editing, Conceptualization. **Shigui Yang:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Funding acquisition, 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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e35026.

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.

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