Vital Surveillances

Burden of Musculoskeletal Disorders — Global and BRICS+ Nations, 1990–2021

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ABSTRACT

Introduction: Musculoskeletal (MSK) disorders are escalating in the BRICS+ nations. The BRICS+ countries include five primary members of Brazil, Russia, India, China, and South Africa, and five new members of Saudi Arabia, Egypt, the United Arab Emirates (UAE), Iran, and Ethiopia by January 1st, 2024.

Methods: Utilizing the Global Burden of Disease (GBD) 2021 database, the study measured MSK disorders burden through incidence, prevalence, and disability-adjusted life years (DALYs), segmented by location, sex, and disease type. The average annual percentage change (AAPC) from 1990 to 2021 was evaluated to track the burden changes.

Results: In 2021, among BRICS+ nations, Brazil (2,267) and China (1,616) presented the highest and lowest age-standardized DALYs of MSK disorders per 100,000, respectively. Females had higher DALYs than males. The largest decrease and increase in age-standardized DALYs from 1990 to 2021 occurred in China (−2.35%) and Saudi Arabia (10.74%), respectively. Among all MSK disorders in 2021, low back pain (LBP) was the leading cause of the DALYs, while gout was the least contributor in BRICS+ nations. For males, the DALYs due to LBP, rheumatoid arthritis (RA), osteoarthritis (OA), neck pain (NP), and other MSK disorders except gout were lower than those for females. From 1990 to 2021, age-standardized DALYs of MSK disorders exhibited a significant decreasing trend in China [AAPC=−0.34; 95% confidence interval (*CI*): −0.38, −0.30], no significant change in Brazil and South Africa, and a growth trend in other nations, with the largest increasing trend detected in Saudi Arabia (AAPC=0.33; 95% *CI*: 0.31, 0.34).

Conclusions: MSK disorders imposed a substantial burden on BRICS+ countries, particularly in Brazil and Iran, with distinct patterns requiring tailored healthcare policies and resource distribution.

Musculoskeletal (MSK) disorders encompass any form of discomfort or permanent and disabling injury affecting the motor organs, including muscles, tendons, bones, cartilage, ligaments, and nerves (*1*). MSK health is fundamental to quality of life across all age groups. Research has demonstrated that individuals with MSK disorders face twice the risk of developing other chronic systemic diseases compared to those without such disorders (*2*). As a major contributor to global disability, MSK disorders pose significant and increasing threats to public health worldwide.

The BRICS group originally comprised Brazil, Russia, India, China, and South Africa, with five additional members — Saudi Arabia, Egypt, the United Arab Emirates (UAE), Iran, and Ethiopia — officially joining on January 1st, 2024, forming "BRICS+". As of 2022, BRICS+ nations represented 45.5% of the global population and approximately 37% of global GDP by 2023 (*3*–*4*), establishing them as increasingly influential contributors to global health and development initiatives. Despite their significance, a comprehensive assessment of MSK disorder burden across these countries remains lacking. This cross-country study utilizes data from the Global Burden of Disease (GBD) 2021 database to examine the disease burden and temporal trends of MSK disorders in BRICS+ nations from 1990 to 2021. The findings will enhance understanding of MSK disorder burden patterns and support the development of effective intervention strategies.

METHODS

The GBD 2021 database, developed by the Institute for Health Metrics and Evaluation (IHME) at University of Washington (*5*), provides a systematic scientific assessment of disease and injury incidence, prevalence, and mortality across 204 countries and territories for 371 diseases and injuries. The GBD

database has standardized crude rates of incidence, prevalence, DALYs, and other metrics by age with reference to the world population.

According to the International Classification of Diseases, 10th Version (ICD-10), GBD 2021 categorizes MSK disorders into 6 major groups: rheumatoid arthritis (RA), osteoarthritis (OA), low back pain (LBP), neck pain (NP), gout, and other MSK diseases (*6*). Since MSK disorders are age-dependent, we primarily used age-standardized indicators, including rates and uncertainty intervals (UI) of incidence, prevalence, and DALYs in this study.

In the GBD study, countries are categorized into four income groups — low, lower-middle, upper-middle, and high — based on their Gross National Income (GNI) per capita, following the World Bank's classification system.

We used the Joinpoint regression program (version 5.0.2, National Cancer Institute, Bethesda, United States) for analysis. The average annual percentage change (AAPC) and its 95% confidence interval (*CI*) from 1990 to 2021 were calculated to determine both the direction and magnitude of the overall trends in disease burden. The significance level was set at α of 0.05.

RESULTS

Globally, the age-standardized incidence rate of MSK disorders decreased from 4.64% in 1990 to 4.35% in 2021. Females consistently exhibited higher age-standardized incidence rates than males. For males, the rate decreased from 3.78% in 1990 to 3.51% in 2021, while for females, it declined from 5.47% to 5.17%. Among BRICS+ nations, Russia reported the highest age-standardized incidence rates in both 1990 (5.93%) and 2021 (5.83%), while China had the lowest rates at 4.04% in 1990 and 3.63% in 2021 (Table 1).

Between 1990 and 2021, Saudi Arabia, UAE, Brazil, and Egypt experienced increases in age-standardized incidence of MSK disorders, led by Saudi Arabia with a 3.55% increase. Conversely, other BRICS+ countries exhibited decreases, with China demonstrating the most substantial decline (–11.28%) (Supplementary Figure S1A, available at https://weekly.chinacdc.cn/). In 2021, sex disparities in age-standardized incidence were most pronounced in India and Iran (Table 1).

The global age-standardized prevalence rate of MSK disorders increased from 19.18% in 1990 to 19.83% in 2021. Among BRICS+ nations, Brazil reported the highest age-standardized prevalence rates in both 1990 (22.39%) and 2021 (22.66%), while Ethiopia had the lowest rates at 16.40% in 1990 and 17.24% in 2021. Saudi Arabia demonstrated the largest increase in prevalence rate (11.19%) from 1990 to 2021.

The global age-standardized DALYs per 100,000 population for MSK disorders increased from 1,886 in 1990 to 1,909 in 2021, with consistently higher rates in females than males. Among BRICS+ nations, Brazil had the highest age-standardized DALYs in both 1990 and 2021, while Ethiopia had the lowest in 1990 and China in 2021. From 1990 to 2021, China exhibited a slight decline with fluctuations in age-standardized DALYs (–2.35%), South Africa showed relatively stable trends, and other BRICS+ countries experienced increases, with Saudi Arabia reporting the largest increase (10.74%) (Supplementary Figure S1). Notably, DALYs were consistently lower in males than females across all global regions and BRICS+ nations in both 1990 and 2021 (Table 1).

Regarding specific disease types, LBP was the leading cause of MSK disorder DALYs globally, decreasing from 937 per 100,000 in 1990 to 832 in 2021, while gout and RA contributed relatively low DALYs (Table 2). Gout DALYs increased slightly from 17 in 1990 to 20 in 2021. Russia exhibited the highest LBP DALYs were at 1,255 per 100,000 in 1990, while India reported the lowest (575) in 2021. Globally, LBP DALYs declined from 1990 to 2021, while RA, OA, NP, and gout remained relatively stable, and other MSK disorders increased. Except for gout, all MSK disorders caused higher DALYs in females than males, a pattern consistent across BRICS+ nations. In 2021, high-income countries had the highest average NP DALYs (309/100,000), upper-middle-income countries had the highest LBP DALYs (900/100,000), and lower-middle-income countries had the highest DALYs for other MSK disorders (582/100,000). Males in high and upper-middle-income countries experienced higher MSK disorder burdens, with high-income countries reporting the highest LBP and gout DALYs. Females in lower-middle-income countries had the highest LBP DALYs, and DALYs for other MSK disorders increased with national income levels (Figure 1).

Table 3 and Supplementary Table S1 (available at https://weekly.chinacdc.cn/) present the joinpoint regression analysis for age-standardized MSK disorder indicators from 1990 to 2021. Globally, MSK incidence rates declined significantly, with an AAPC of

TABLE 1. Age-standardized incidence, prevalence, and DALYs rates of MSK disorders in 1990 and 2021 in BRICS+ nations.

Country	Sex	Age-standardized incidence (%)				Age-standardized prevalence (%)				Age-standardized DALYs (per 100,000)			
		1990		2021		1990		2021		1990		2021	
		Rate	95% *UI*	Rate	95% *UI*	Rate	95% *UI*	Rate	95% *UI*	Rate	95% *UI*	Rate	95% *UI*
Global	Both	4.64	4.20−5.10	4.35	3.96–4.76	19.18	18.08–20.28	19.83	18.81–20.94	1,886	1,380–2,523	1,909	1,395–2,548
	Male	3.78	3.42–4.14	3.51	3.20–3.84	16.06	15.11–17.04	16.72	15.81–17.70	1,493	1,083–1,995	1,518	1,104–2,029
	Female	5.47	4.94–6.03	5.17	4.69–5.67	22.16	20.94–23.39	22.85	21.69–24.07	2,261	1,667–3,015	2,286	1,675–3,051
High-income countries													
Saudi	Both	4.62	4.17–5.09	4.79	4.33–5.28	17.61	16.48–18.74	19.58	18.37–20.85	1,685	1,219–2,237	1,866	1,364–2,483
Arabia	Male	3.96	3.57–4.34	4.11	3.72–4.53	14.66	13.67–15.70	16.37	15.26–17.55	1,319	952–1,782	1,452	1,042–1,963
	Female	5.60	5.05–6.19	5.80	5.22–6.39	22.04	20.44–23.63	24.38	22.91–26.08	2,234	1,625–2,967	2,489	1,807–3,261
UAE	Both	4.32	3.91–4.72	4.47	4.06–4.89	17.54	16.49–18.59	19.19	18.14–20.34	1,668	1,204–2,219	1,813	1,310–2,433
	Male	3.78	3.39–4.12	3.96	3.57–4.34	15.26	14.28–16.25	17.15	16.14–18.22	1,378	988–1,860	1,551	1,115–2,071
	Female	5.45	4.94–5.98	5.69	5.12–6.24	22.45	21.02–23.96	24.66	23.26–26.19	2,282	1,665–3,019	2,542	1,870–3,357
Upper-middle-income countries													
Brazil	Both	5.00	4.51–5.54	5.15	4.65–5.68	22.39	21.1–23.72	22.66	21.37–24.02	2,251	1,664–2,995	2,267	1,670–3,018
	Male	4.07	3.67–4.48	4.20	3.80–4.62	19.19	17.97–20.44	19.44	18.25–20.69	1,824	1,330–2,427	1,837	1,341–2,456
	Female	5.87	5.27–6.53	6.03	5.42–6.67	25.38	23.94–26.78	25.60	24.17–27.13	2,648	1,978–3,513	2,658	1,977–3,518
Russia	Both	5.93	5.34–6.54	5.83	5.26–6.42	20.00	18.72–21.27	20.23	19.00–21.48	1,978	1,449–2,688	2,003	1,470–2,717
	Male	4.96	4.48–5.45	4.86	4.39–5.34	16.45	15.40–17.51	16.72	15.68–17.86	1,491	1,087–2,052	1,519	1,105–2,087
	Female	6.72	6.04–7.43	6.65	6.00–7.32	22.77	21.28–24.27	23.11	21.71–24.54	2,343	1,730–3,149	2,387	1,760–3,218
China	Both	4.04	3.65–4.44	3.63	3.31–3.95	16.97	15.95–17.98	17.40	16.41–18.41	1,616	1,170–2,151	1,578	1,140–2,129
	Male	3.30	2.99–3.60	3.08	2.82–3.37	14.40	13.51–15.33	15.20	14.28–16.19	1,306	944–1,739	1,318	946–1,774
	Female	4.79	4.30–5.29	4.18	3.80–4.55	19.56	18.37–20.70	19.59	18.37–20.70	1,930	1,400–2,580	1,839	1,333–2,484
South	Both	4.26	3.86–4.65	4.12	3.74–4.51	17.70	16.67–18.72	18.35	17.32–19.37	1,707	1,255–2,256	1,713	1,262–2,267
Africa	Male	3.52	3.19–3.84	3.51	3.20–3.83	15.31	14.41–16.22	16.30	15.44–17.21	1,359	990–1,831	1,428	1,043–1,920
	Female	4.91	4.44–5.39	4.66	4.22–5.14	19.77	18.58–20.97	20.18	18.99–21.36	2,003	1,476–2,654	1,962	1,447–2,591
Egypt	Both	4.80	4.33–5.31	4.95	4.48–5.46	18.62	17.51–19.85	20.48	19.26–21.76	1,836	1,339–2,445	2,018	1,473–2,678
	Male	4.00	3.61–4.43	4.14	3.75–4.56	15.25	14.23–16.33	17.06	16.05–18.22	1,421	1,025–1,912	1,589	1,154–2,131
	Female	5.63	5.10–6.22	5.83	5.25–6.45	22.15	20.74–23.73	24.24	22.77–25.79	2,269	1,651–2,997	2,489	1,818–3,266
Lower-middle-income countries													
India	Both	4.13	3.72–4.55	3.80	3.44–4.17	18.95	17.83–20.15	19.95	18.83–21.24	1,835	1,361–2,417	1,906	1,407–2,510
	Male	3.04	2.74–3.33	2.66	2.41–2.91	15.36	14.4–16.39	15.86	14.83–16.92	1,411	1,044–1,864	1,419	1,037–1,880
	Female	5.31	4.77–5.87	4.94	4.45–5.44	22.85	21.55–24.26	24.07	22.75–25.55	2,294	1,705–3,016	2,394	1,773–3,143
Iran	Both	5.65	5.08–6.23	5.40	4.88–5.94	19.99	18.63–21.34	21.02	19.74–22.35	2,036	1,489–2,707	2,112	1,540–2,812
	Male	4.76	4.29–5.23	4.35	3.92–4.76	16.35	15.22–17.47	17.07	16.02–18.22	1,581	1,152–2,127	1,612	1,167–2,172
	Female	6.59	5.94–7.29	6.49	5.86–7.16	23.82	22.2–25.38	25.06	23.5–26.62	2,515	1,840–3,324	2,621	1,910–3,479
Low-income countries													
Ethiopia	Both	4.47	4.02–4.92	4.32	3.91–4.75	16.40	15.34–17.44	17.24	16.20–18.29	1,581	1,166–2,105	1,613	1,171–2,156
	Male	3.82	3.44–4.20	3.71	3.35–4.06	14.28	13.35–15.23	15.25	14.28–16.22	1,325	975–1,775	1,372	990–1,851
	Female	5.12	4.61–5.66	4.94	4.45–5.45	18.53	17.32–19.67	19.25	18.05–20.44	1,841	1,354–2,444	1,855	1,359–2,479

Abbreviation: MSK=musculoskeletal; DALYs=disability-adjusted life years; *UI*=uncertainty interval.

TABLE 2. Age-standardized DALYs (95% *UI*) per 100,000 population for different MSK disorders in BRICS+ nations by sex in 1990 and 2021.

Country	Sex	RA		OA		LBP		NP		Gout		Other MSK disorders	
		1990	2021	1990	2021	1990	2021	1990	2021	1990	2021	1990	2021
Global	Both	36 (29–46)	36 (27–46)	223 (107–450)	245 (117–493)	937 (669–1,261)	832 (596–1,115)	242 (162–344)	242 (163–343)	17 (11–24)	20 (14–29)	431 (306–585)	534 (375–724)
	Male	22 (17–28)	22 (17–29)	182 (88–369)	201 (96–405)	721 (512–974)	635 (454–854)	203 (135–288)	199 (134–284)	26 (18–38)	32 (21–45)	338 (237–467)	429 (298–589)
	Female	50 (39–64)	49 (36–64)	258 (123–520)	284 (136–573)	1–142 (817–1,533)	1–022 (732–1,370)	280 (187–399)	285 (190–402)	8 (5–12)	10 (7–14)	523 (375–704)	637 (450–858)
High-income countries													
Saudi Arabia	Both	9 (6–12)	15 (10–21)	193 (93–389)	233 (112–468)	888 (629–1191)	907 (646–1,205)	331 (220–471)	331 (221–471)	15 (10–22)	20 (14–28)	249 (169–356)	361 (253–509)
	Male	4 (2–5)	7 (5–10)	173 (83–347)	207 (100–416)	753 (524–1013)	768 (548–1,021)	210 (137–297)	208 (136–297)	20 (13–30)	26 (18–38)	160 (96–246)	235 (156–352)
	Female	17 (11–23)	26 (18–38)	222 (107–444)	271 (130–541)	1–083 (774–1,443)	1–110 (783–1,481)	519 (346–747)	518 (346–749)	7 (5–11)	10 (6–14)	387 (279–532)	553 (400–757)
UAE	Both	14 (10–19)	16 (12–23)	201 (96–407)	221 (105–444)	803 (571–1,068)	824 (589–1,101)	302 (201–428)	287 (192–408)	18 (12–26)	24 (16–34)	331 (231–457)	442 (308–604)
	Male	8 (6–11)	8 (6–12)	181 (87–369)	207 (98–418)	693 (494–935)	724 (518–974)	210 (138–302)	210 (137–298)	23 (15–33)	27 (19–40)	262 (171–373)	374 (251–526)
	Female	26 (18–37)	41 (28–55)	234 (111–480)	268 (128–543)	1–016 (724–1,356)	1–059 (758–1,403)	520 (346–752)	517 (347–750)	8 (5–12)	10 (6–14)	478 (344–647)	647 (471–869)
Upper-middle-income countries													
Brazil	Both	29 (21–38)	28 (21–37)	228 (109–460)	260 (125–525)	1–002 (715–1,345)	1–034 (745–1,388)	276 (185–397)	276 (185–398)	6 (4–9)	8 (5–11)	709 (509–961)	660 (469–899)
	Male	17 (13–23)	16 (12–22)	206 (99–416)	229 (110–462)	767 (548–1,031)	793 (563–1,061)	246 (166–356)	247 (165–358)	9 (6–12)	11 (7–15)	578 (413–798)	541 (380–750)
	Female	39 (29–52)	39 (28–51)	247 (119–497)	286 (138–575)	1–222 (871–1,639)	1–254 (908–1,677)	304 (202–435)	304 (202–435)	4 (3–6)	6 (4–8)	832 (602–1,118)	770 (554–1,034)
Russia	Both	35 (28–44)	38 (29–49)	279 (133–566)	286 (137–579)	1–255 (899–1,690)	1–206 (867–1,623)	268 (180–384)	268 (180–384)	11 (8–16)	13 (9–19)	130 (92–179)	191 (139–263)
	Male	16 (13–21)	19 (15–24)	242 (116–493)	250 (120–506)	955 (683–1,293)	923 (657–1,241)	242 (162–349)	243 (163–350)	20 (14–29)	23 (15–32)	15 (12–22)	61 (41–93)
	Female	49 (38–61)	53 (40–69)	300 (142–601)	310 (147–623)	1–481 (1–065–1,985)	1–433 (1–032–1,926)	290 (192–417)	290 (192–416)	6 (4–9)	7 (5–11)	218 (155–305)	294 (212–400)
China	Both	42 (33–54)	42 (31–55)	211 (102–424)	245 (117–492)	749 (530–1,014)	603 (428–810)	248 (164–353)	255 (167–358)	20 (13–29)	25 (17–36)	346 (241–476)	408 (283–564)
	Male	28 (20–36)	31 (23–40)	169 (81–341)	197 (94–397)	572 (402–779)	488 (347–658)	214 (142–308)	216 (145–308)	30 (20–44)	39 (26–55)	293 (202–410)	347 (238–485)
	Female	58 (44–74)	54 (39–73)	251 (121–503)	290 (139–583)	926 (658–1,253)	716 (506–960)	284 (188–406)	294 (194–414)	10 (7–15)	12 (8–18)	402 (284–547)	472 (333–647)
South Africa	Both	73 (57–92)	56 (43–72)	242 (116–487)	260 (126–521)	759 (540–1,019)	693 (498–928)	293 (195–422)	289 (192–413)	16 (11–23)	17 (12–25)	324 (236–443)	397 (287–532)
	Male	59 (44–76)	44 (34–60)	234 (113–471)	250 (121–504)	574 (409–769)	557 (396–748)	227 (150–332)	226 (149–326)	27 (18–39)	29 (20–42)	239 (170–336)	322 (230–443)
	Female	85 (66–108)	66 (50–83)	247 (118–497)	266 (128–537)	913 (650–1,225)	812 (582–1,086)	353 (233–506)	348 (230–495)	8 (5–11)	9 (6–12)	397 (290–532)	462 (338–616)

Continued

Country	Sex	RA		OA		LBP		NP		Gout		Other MSK disorders	
		1990	2021	1990	2021	1990	2021	1990	2021	1990	2021	1990	2021
Egypt	Both	11 (8–16)	16 (11–22)	184 (89–376)	213 (103–441)	944 (670–1,267)	965 (698–1,290)	364 (240–521)	358 (238–510)	14 (9–20)	18 (12–26)	319 (213–447)	448 (310–610)
	Male	4 (3–6)	6 (4–9)	165 (79–329)	189 (90–397)	778 (546–1,052)	800 (567–1,081)	211 (136–303)	210 (138–303)	21 (14–30)	25 (16–36)	242 (159–347)	358 (245–508)
	Female	19 (13–26)	28 (19–38)	205 (98–421)	241 (116–493)	1–117 (801–1,508)	1–145 (826–1,520)	523 (345–757)	520 (343–755)	7 (5–11)	9 (6–13)	398 (274–552)	547 (382–743)
Lower-middle-income countries													
India	Both	35 (26–44)	41 (32–52)	185 (90–375)	221 (106–447)	824 (594–1,107)	714 (509–955)	157 (105–226)	159 (105–228)	12 (8–17)	13 (9–19)	621 (441–842)	758 (535–1,027)
	Male	21 (14–27)	24 (17–30)	144 (70–291)	168 (81–340)	556 (396–747)	445 (315–599)	138 (92–201)	139 (92–201)	17 (12–25)	19 (13–28)	535 (378–727)	625 (435–852)
	Female	49 (38–64)	57 (44–73)	229 (110–460)	272 (130–545)	1–114 (804–1,493)	984 (704–1,320)	179 (118–256)	179 (118–256)	6 (4–9)	7 (5–10)	717 (509–967)	896 (638–1,210)
Iran	Both	10 (7–14)	13 (9–19)	187 (89–377)	215 (103–433)	1–132 (811–1,523)	1–028 (740–1,370)	432 (287–618)	433 (289–618)	14 (9–20)	15 (10–22)	263 (178–371)	407 (284–560)
	Male	3 (2–5)	5 (3–7)	167 (80–337)	187 (90–380)	936 (667–1,256)	804 (573–1,074)	289 (192–417)	290 (192–415)	20 (13–29)	22 (15–32)	166 (104–246)	304 (209–433)
	Female	17 (12–23)	22 (15–30)	207 (99–419)	242 (115–484)	1–335 (962–1,788)	1–257 (909–1,674)	582 (385–830)	580 (384–825)	7 (5–10)	8 (5–12)	366 (254–503)	512 (361–698)
Low-income country													
Ethiopia	Both	12 (8–20)	11 (7–15)	174 (84–354)	221 (106–444)	884 (632–1,180)	822 (584–1,106)	236 (155–337)	237 (156–338)	13 (9–19)	14 (9–20)	262 (183–358)	307 (207–427)
	Male	10 (7–14)	9 (6–12)	155 (75–312)	198 (95–397)	720 (511–960)	673 (479–903)	208 (137–295)	209 (137–294)	19 (13–28)	21 (14–30)	214 (144–303)	263 (172–375)
	Female	14 (9–29)	13 (8–20)	195 (94–396)	245 (118–491)	1–052 (753–1,405)	973 (689–1,306)	264 (172–376)	266 (173–379)	7 (4–10)	7 (5–11)	310 (224–419)	352 (243–478)

Abbreviation: DALYs=disability adjusted life years; MSK=musculoskeletal; RA=rheumatoid arthritis; OA=osteoarthritis; LBP=low back pain; NP=neck pain; *UI*=uncertainty interval.

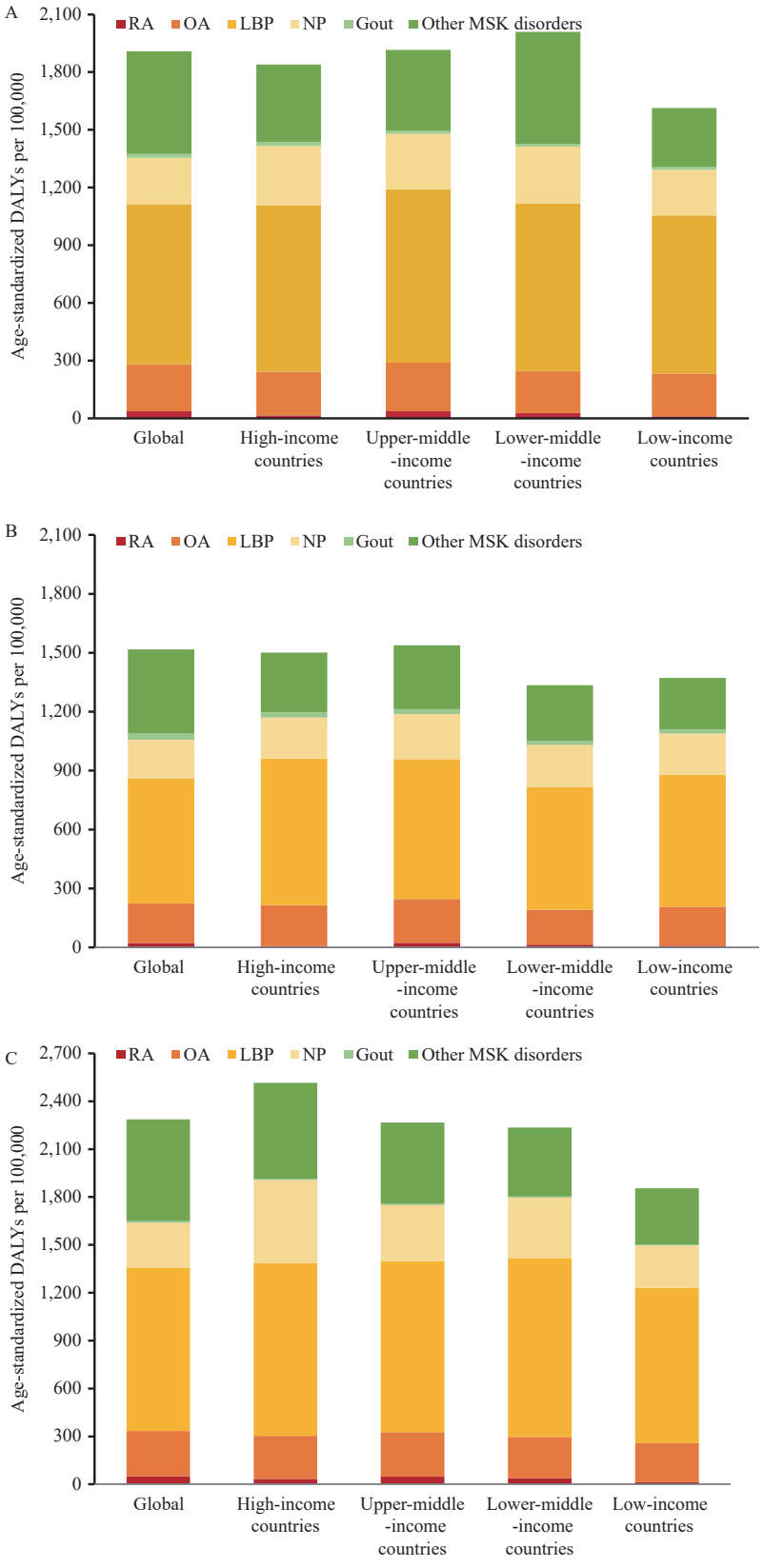

FIGURE 1. Age-standardized DALYs caused by different types of MSK disorders by sex in BRICS+ nations, 2021. (A) Both sexes; (B) Male; (C) Female.
Abbreviations: DALYs=disability adjusted life years; MSK=musculoskeletal; RA=rheumatoid arthritis; OA=osteoarthritis; LBP=low back pain; NP=neck pain.

TABLE 3. The trend of age-standardized incidence, prevalence, and DALYs rates (per 100,000 population) for MSK disorders in BRICS+ nations from 1990 to 2021.

Country	Age-standardized incidence			Age-standardized prevalence			Age-standardized DALYs		
	AAPC	95% *CI*	*P*	AAPC	95% *CI*	*P*	AAPC	95% *CI*	*P*
Global	−0.21	−0.22, −0.20	<0.001	0.11	0.09, 0.13	<0.001	0.04	0.02, 0.06	<0.001
High-income countries									
Saudi Arabia	0.12	0.11, 0.12	<0.001	0.34	0.33, 0.35	<0.001	0.33	0.32, 0.34	<0.001
UAE	0.11	0.11, 0.12	<0.001	0.29	0.28, 0.30	<0.001	0.27	0.25, 0.29	<0.001
Upper-middle-income countries									
Brazil	0.10	0.08, 0.11	<0.001	0.04	0.03, 0.05	<0.001	0.02	−0.01, 0.04	0.066
Russia	−0.05	−0.06, −0.04	<0.001	0.04	0.03, 0.06	<0.001	0.04	0.01, 0.08	0.033
China	−0.34	−0.38, −0.30	<0.001	0.09	0.07, 0.11	<0.001	−0.06	−0.10, −0.02	0.005
South Africa	−0.11	−0.12, −0.10	<0.001	0.12	0.10, 0.13	<0.001	0.01	−0.01, 0.03	0.273
Egypt	0.10	0.09, 0.11	<0.001	0.31	0.30, 0.31	<0.001	0.30	0.29, 0.32	<0.001
Lower-middle-income countries									
India	−0.27	−0.33, −0.21	<0.001	0.16	0.10, 0.21	<0.001	0.12	0.06, 0.17	<0.001
Iran	−0.13	−0.15, −0.11	<0.001	0.17	0.15, 0.18	<0.001	0.12	0.10, 0.15	<0.001
Low-income country									
Ethiopia	−0.11	−0.11, −0.10	<0.001	0.16	0.15, 0.17	<0.001	0.07	0.06, 0.08	<0.001

Abbreviation: DALYs=disability-adjusted life years; MSK=musculoskeletal; *CI*=confidence interval; AAPC=average annual percentage change.

−0.21 [95% confidence interval (*CI*): −0.22, −0.20]. Among BRICS+ nations, Saudi Arabia, UAE, Brazil, and Egypt showed increasing trends, while others declined, with China experiencing the largest decrease [average annual percentage change (AAPC)=−0.34; 95% *CI*: −0.38, −0.30] and Saudi Arabia had the largest increase (AAPC=0.12; 95% *CI*: 0.11, 0.12). Age-standardized prevalence rates increased globally and across all BRICS+ nations, with Saudi Arabia showing the most substantial increase (AAPC=0.34; 95% *CI*: 0.33, 0.35). China's MSK DALYs demonstrated a significant decline, while other nations, except Brazil and South Africa, showed growth, with Saudi Arabia and UAE leading the increase. Globally, DALYs exhibited a fluctuating trend with an AAPC of 0.04% (95% *CI*: 0.02%, 0.06%). High-income countries like Saudi Arabia experienced a consistent increase in DALYs, while lower-middle-income countries like India and Iran showed M-shaped trends. Ethiopia, a low-income nation, experienced a down-up-down trend. Upper-middle-income countries displayed varied trends, with Egypt's DALYs increasing until 2019 before stabilizing. Russia, China, and South Africa initially showed declining DALYs, with China exhibiting a unique down-stable-up-stable-up pattern. Sex differences in DALY trends were complex and varied by country. The trend in DALYs among males in China was more complex compared to females, while the opposite was true in South Africa. Moreover, the AAPCs for males in both countries were positive, differing from those for females.

DISCUSSION

This study analyzed the disease burden, major types, and trends of MSK disorders in BRICS+ nations between 1990 and 2021 using the GBD 2021 database. The 10 countries are classified into different income levels, including high, upper-middle, lower-middle, and low-income countries. Overall, MSK disorders imposed a heavier disease burden on females than males across BRICS+ countries, with higher rates observed in lower-middle and upper-middle income countries.

From 1990 to 2021, Russia maintained the highest age-standardized incidence of MSK disorders, while China consistently reported the lowest. Among BRICS+ nations, Saudi Arabia showed the largest increase (3.55%) in age-standardized incidence, with Brazil and Egypt are also demonstrating upward trends. Conversely, China experienced the most substantial decline (−11.28%) in age-standardized incidence. Regarding age-standardized prevalence, MSK disorders were most common in Brazil, followed

by Iran and Russia, and least common in Ethiopia and China. Saudi Arabia exhibited the largest increase in prevalence (11.19%) over the past three decades.

Brazil had the highest age-standardized DALYs per 100,000 population for MSK disorders among BRICS+ nations in both 1990 and 2021. Saudi Arabia, UAE, and Egypt showed consistent increasing trends in DALYs, with Saudi Arabia experiencing the largest increase (10.74%). YLDs caused by metabolic, behavioral, and environmental or occupational risk factors have been increasing across all age groups in Saudi Arabia, thereby exacerbating the burden of MSK disorders (*7*). China demonstrated the largest decrease in DALYs (–2.35%), primarily due to reductions in low back pain, related to improvements in sanitation and healthcare services. However, with rapid population aging, China will face immense challenges in managing the burden of MSK disorders in the future (*8*–*9*). The DALYs attributed to MSK disorders in Ethiopia remained relatively low, which may be related to poor documentation of the magnitude of NCDs at both national and subnational levels (*10*).

Sex disparities in MSK disorders are evident, with females experiencing a greater disease burden than males both globally and across BRICS+ nations. These differences likely stem from physiological factors such as ligament relaxation, hormonal influences (estrogen and progesterone), and behavioral factors, including exercise habits and work posture (*11*). Pregnancy and menopause significantly contribute to MSK disorders in females (*12*). Saudi Arabia exhibited the largest sex disparity in 2021, followed by Iran, which can be attributed to differences in life expectancy and cultural gender inequalities (*13*).

LBP was the predominant contributor to MSK-related DALYs in 2021, with Russia showing the highest burden, followed by Brazil and Iran. High body mass index (BMI), a significant risk factor for MSK disorders, may explain the elevated DALYs in these countries (*14*–*15*). Additionally, increased tobacco use in Iran potentially influences LBP prevalence (*15*). While gout had comparatively low DALYs globally and across BRICS+ nations, it imposed a greater burden on males, possibly due to unhealthy lifestyle behaviors such as smoking and alcohol consumption, as well as hormonal differences.

As life expectancy increases across BRICS+ nations, maintaining physical function and quality of life becomes increasingly challenging, particularly for females who generally live longer. MSK health is fundamental to quality of life across all age groups. Occupational risks, tobacco use, high BMI, and kidney dysfunction were the primary contributors to MSK disorder DALYs globally, accounting for over 20% of the global burden (*6*). BRICS+ countries could benefit from strengthened coordination in policy development and implementation to collectively advance global MSK health.

This study has several limitations. First, it relies on GBD modeling, which may not fully capture the actual situation, particularly in less developed countries. Second, some MSK disorders were grouped together without specific analysis. Finally, the study did not consider different age groups, which will be addressed in future research.

Conflicts of interest: No conflicts of interest.

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SUPPLEMENTARY MATERIAL

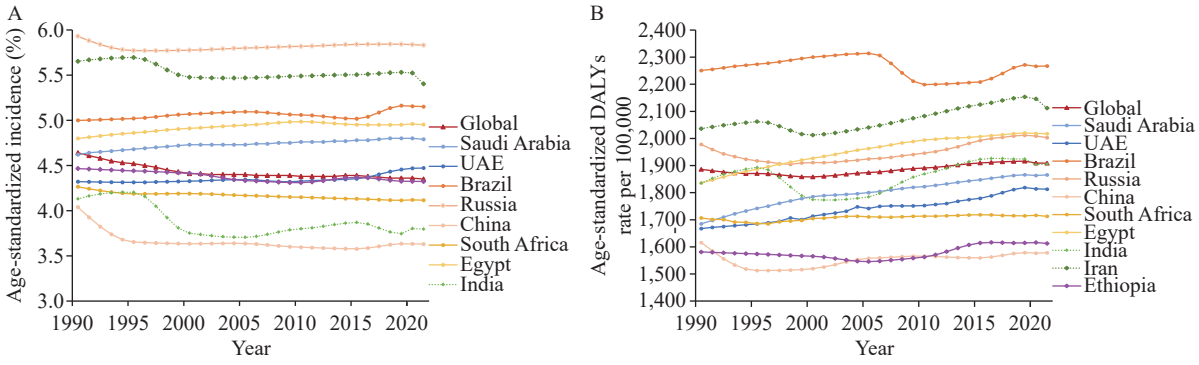
SUPPLEMENTARY TABLE S1. Log-transformed joinpoint trends of MSK disorders DALYs by sex in BRICS+ nations between 1990 and 2021.

Country	Sex	Trend 1		Trend 2		Trend 3		Trend 4		Trend 5		Trend 6		1990–2021 AAPC, (95% *CI*)
		Years	APC	Years	APC	Years	APC	Years	APC	Years	APC	Years	APC	
Global	Both	1990–1993	−0.25*	1993–1996	−0.05*	1996–2000	−0.16*	2000–2016	0.18*	2016–2019	0.06	2019–2021	−0.21*	0.04* (0.02–0.06)
	Male	1990–2003	−0.13*	1993–1996	0.01	1996–2000	−0.13*	2000–2018	0.18*	2018–2021	−0.24*	NA	NA	0.05* (0.03–0.08)
	Female	1990–1992	−0.34*	1992–2000	−0.15*	2000–2017	0.18*	2017–2021	−0.04	NA	NA	NA	NA	0.04* (0.02–0.05)
High-income countries														
Saudi Arabia	Both	1990–1994	0.70*	1994–2000	0.51*	2000–2004	0.13*	2004–2012	0.25*	2012–2018	0.28*	2018–2021	0.03*	0.33* (0.31–0.34)
	Male	1990–1994	0.81*	1994–2000	0.50*	2000–2004	−0.07*	2004–2010	0.09*	2010–2018	0.34*	2018–2021	0.10*	0.31* (0.29–0.32)
	Female	1990–1994	0.56*	1994–2000	0.34*	2000–2004	0.20*	2004–2010	0.52*	2010–2018	0.33*	2018–2021	−0.02	0.35* (0.33–0.36)
UAE	Both	1990–1997	0.22*	1997–2005	0.40*	2005–2011	0.07*	2011–2015	0.35*	2015–2019	0.55*	2019–2021	−0.21*	0.27* (0.25–0.29)
	Male	1990–2008	0.41*	2008–2015	0.27*	2015–2019	0.63*	2019–2021	−0.03	NA	NA	NA	NA	0.38* (0.37–0.39)
	Female	1990–2003	0.32*	2003–2008	0.50*	2008–2011	0.15	2011–2019	0.62*	2019–2021	−0.72*	NA	NA	0.34* (0.32–0.37)
Upper−middle-income countries														
Brazil	Both	1990–2003	0.21*	2003–2006	−0.02	2006–2009	−1.56*	2009–2015	0.01	2015–2019	0.77*	2019–2021	−0.18*	0.02 (–0.01–0.04)
	Male	1990–2005	0.29*	2005–2010	−1.50*	2010–2015	0.22*	2015–2019	0.72*	2019–2021	−0.06	NA	NA	0.02 (–0.00–0.04)
	Female	1990–2002	0.14*	2002–2006	0.00	2006–2009	−1.20*	2009–2015	−0.04*	2015–2019	0.76*	2019–2021	−0.23*	0.01 (–0.01–0.04)
Russia	Both	1990–1993	−0.79*	1993–1998	−0.29*	1998–2010	0.17*	2010–2016	0.50*	2016–2019	0.19	2019–2021	−0.22	0.04* (0.01–0.08)
	Male	1990–1992	−0.89*	1992–1997	−0.34*	1997–2007	0.17*	2007–2011	0.25*	2011–2016	0.55*	2016–2021	0.01	0.06* (0.04–0.09)
	Female	1990–1993	−0.73*	1993–1997	−0.32*	1997–2004	0.08*	2004–2010	0.24*	2010–2018	0.48*	2018–2021	−0.11	0.07* (0.04–0.09)
China	Both	1990–1994	−1.58*	1994–2000	0.06	2000–2004	0.60*	2004–2009	0.17*	2009–2014	−0.10	2014–2021	0.20*	−0.06* (−0.10–−0.02)
	Male	1990–1994	−0.78*	1994–2000	0.04	2000–2005	0.53*	2005–2015	−0.07*	2015–2018	0.60*	2018–2021	0.08	0.03* (0.01–0.06)
	Female	1990–1994	−2.13*	1994–2000	0.07	2000–2004	0.57*	2004–2010	0.23*	2010–2014	−0.20*	2014–2021	0.13*	−0.14* (−0.18–−0.11)
South Africa	Both	1990–1995	−0.26*	1995–2003	0.21*	2003–2007	−0.05	2007–2015	0.06*	2015–2021	−0.05*	NA	NA	0.01 (−0.01–0.03)
	Male	1990–1994	−0.09*	1994–1998	0.25*	1998–2005	0.14*	2005–2015	0.28*	2015–2021	0.08*	NA	NA	0.16* (0.14–0.17)
	Female	1990–1996	−0.40*	1996–2003	0.23*	2003–2007	−0.14	2007–2021	−0.04*	NA	NA	NA	NA	−0.06* (−0.08–−0.04)
Egypt	Both	1990–1993	0.60*	1993–1998	0.47*	1998–2009	0.36*	2009–2019	0.14*	2019–2021	−0.06	NA	NA	0.30* (0.29–0.32)
	Male	1990–1993	0.68*	1993–1999	0.53*	1999–2009	0.40*	2009–2015	0.17*	2015–2019	0.25*	2019–2021	−0.05	0.36* (0.34–0.38)
	Female	1990–1993	0.56*	1993–1997	0.45*	1997–2007	0.38*	2007–2010	0.33*	2010–2019	0.13*	2019–2021	−0.10*	0.30* (0.29–0.31)

Continued

Country	Sex	Trend 1		Trend 2		Trend 3		Trend 4		Trend 5		Trend 6		1990–2021 AAPC, (95% *CI*)
		Years	APC	Years	APC	Years	APC	Years	APC	Years	APC	Years	APC	
Lower−middle-income countries														
India	Both	1990–1995	0.69*	1995–2000	−1.43*	2000–2005	0.11	2005–2009	1.07*	2009–2016	0.57*	2016–2021	−0.29*	0.12* (0.06–0.17)
	Male	1990–1995	0.64*	1995–2000	−1.63*	2000–2005	0.15	2005–2010	1.02*	2010–2018	0.34*	2018–2021	−1.18*	−0.00 (−0.12–0.12)
	Female	1990–1995	0.68*	1995–2000	−1.38*	2000–2005	0.02	2005–2009	0.99*	2009–2015	0.63*	2015–2021	−0.04	0.13* (0.09–0.17)
Iran	Both	1990–1995	0.28*	1995–2000	−0.54*	2000–2003	0.26*	2003–2019	0.40*	2019–2021	−0.98*	NA	NA	0.12* (0.10–0.15)
	Male	1990–1995	0.32*	1995–2000	−0.96*	2000–2009	0.44*	2009–2015	0.69*	2015–2019	0.08	2019–2021	−1.34*	0.08* (0.06–0.10)
	Female	1990–1995	0.24*	1995–2000	−0.28*	2000–2015	0.23*	2015–2019	0.58*	2019–2021	−0.66*	NA	NA	0.13* (0.12–0.15)
Low-income country														
Ethiopia	Both	1990–2000	−0.10*	2000–2005	−0.28*	2005–2010	0.22*	2010–2015	0.69*	2015–2021	−0.03*	NA	NA	0.07* (0.06–0.08)
	Male	1990–2000	−0.01*	2000–2005	−0.15*	2005–2010	0.33*	2010–2015	0.74*	2015–2019	−0.33*	2019–2021	0.10*	0.11* (0.10–0.12)
	Female	1990–1999	−0.07*	1999–2005	−0.36*	2005–2010	0.08*	2010–2015	0.59*	2015–2019	0.16*	2019–2021	−0.22*	0.02* (0.01–0.04)

Abbreviation: DALYs=disability adjusted life years; MSK=musculoskeletal; *CI*=confidence interval; APC=annual percentage change; AAPC=average annual percentage change; NA=not applicable.
* *P*<0.05.



SUPPLEMENTARY FIGURE S1. Age-standardized rates of MSK disorders in BRICS+ nations, 1990–2021. (A) Age-standardized incidence (%); (B) Age-standardized DALYs rate (per 100,000).
Abbreviation: DALYs=disability adjusted life years; MSK=musculoskeletal.