



Burden of Musculoskeletal and Headache Disorders in Asian Countries, 1990–2021: A Cross-Sectional Analysis of the Global Burden of Disease Study 2021

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(Received 16 Feb 2025; accepted 26 May 2025)

Abstract

Background: Comprehensive and updated data on the prevalence, incidence, mortality, and disability rates of musculoskeletal (MSK) and headache disorders in Asia are scarce. We aimed to analyze the trends in incidence, prevalence, mortality, and disability-adjusted life years (DALYs) related to these disorders from 1990 to 2021.

Methods: We assessed the burden of MSK and headache disorders across Asia utilizing data from the Global Burden of Disease study. We evaluated the trends in DALYs, mortality, incidence, and prevalence and their changes over time. Correlations with the sociodemographic index were examined to determine potential influencing factors.

Results: In 2021, MSK and headache disorders accounted for 120 million DALYs (95% uncertainty interval: 72.5–182.3 million), reflecting a 94% increase since 1990. Furthermore, mortality increased by 138% over the same period. Lower back pain was the leading contributor to DALYs (36.9 million), followed by migraine (25.4 million) and knee osteoarthritis (7.4 million). From 1990 to 2021, DALYs due to osteoarthritis and gout increased by 15% and 170%, respectively. DALYs due to rheumatoid arthritis (RA) remained stable, although RA-related mortality increased by 117%. Age-standardized rates exhibited minimal variation, with the highest burden observed in individuals aged 50–54 years and a higher prevalence among females.

Conclusion: MSK and headache disorders were leading causes of disability in Asia, with significant increments in both DALYs and mortality over the past three decades. These trends underscore the urgent need for targeted prevention and management strategies, particularly for high-burden conditions like lower back pain, migraine, and osteoarthritis.

Keywords: Musculoskeletal disorder; Headache; Osteoarthritis; Disability-adjusted life years

Introduction

Musculoskeletal (MSK) and headache disorders are among the leading causes of nonfatal health burdens globally, as highlighted by the Global

Burden of Disease (GBD) study (1, 2). According to GBD 2021, low back pain (LBP), neck pain (NP), and osteoarthritis (OA) rank among the



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DOI: <https://doi.org/10.18502/ijph.v54i9.19856>

top 10 causes of years lived with disability (YLDs), collectively accounting for over 100 million YLDs, while migraine and tension-type headache (TTH) contribute over 80 million (3, 4). These conditions significantly impair daily functioning, especially in younger populations (5, 6). Despite their substantial burden, comprehensive and harmonized epidemiological data on MSK and headache disorders in the context of Asia remain scarce. While Europe benefits from registries like EULAR and the U.S. relies on large-scale surveys such as NHANES, Asia lacks comparable data infrastructures (7, 8). Moreover, most previous research has centered on Western populations, often overlooking Asia's distinct demographic, cultural, and socioeconomic contexts (5, 9). Notably, regional differences—such as the higher prevalence of OA among Asian men or the predominance of occupational over metabolic risk factors in Asian LBP—highlight the necessity of Asia-specific analysis (10, 11). GBD models adjust for variables like healthcare access and education, but many Asian regions still rely on limited primary data, making the validation of local data critical (1, 12). To address these gaps, our study provides a refined, sub-regional perspective and integrates updated risk profiles to inform targeted policy interventions. This study examined trends in relation to the sociodemographic index (SDI), which reflects income, education, and fertility, as it influences disease patterns through healthcare access, health literacy, and demographic shifts (13, 14). Our findings offer evidence-based insights to guide resource allocation, highlighting the need for strengthened workplace safety measures, expanded rehabilitation services for aging populations, improved healthcare access in low-SDI regions, and enhanced public health education to promote preventive behaviors in Asia.

Methods

GBD database

Conditions including rheumatoid arthritis (RA), hand, hip, knee, and other OA, LBP, NP, gout,

other MSK disorders, migraine, and TTH were categorized as shown in eTables 1-2 (Not published) (15). Medication overuse headache, previously classified as a distinct disorder, has been reclassified as a complication or secondary condition of primary headaches like migraine or TTH according to the International Classification of Diseases, 11th Revision (ICD-11) and International Classification of Headache Disorders, 3rd edition (16). Injuries caused by external factors (e.g., falls, traffic accidents) were excluded, as they are categorized separately under the ICD guidelines. The focus was placed on degenerative and related conditions (17). Non-fatal and mortality estimates, YLDs, years of life lost (YLLs), and DALYs were used as key metrics (18, 19).

Asian subregions

Forty-nine countries and territories were grouped into East, Southeast, Central, South, and Western Asia, as classified by the United Nations, to examine geographic differences (20).

Risk factors

The GBD Comparative Risk Assessment framework was employed to estimate exposure to risk factors associated with MSK and headache disorders (21). Relative risk data were aggregated through meta-analyses of randomized controlled trials, cohort, and case-control studies. Summary exposure values, reflecting risk-weighted prevalence (0%–100%), were calculated using mean exposure levels as covariates (22).

SDI

The SDI, representing national income, average schooling, and fertility rates (range: 0–1), was categorized into low, low-middle, middle, high-middle, and high, consistent with prior research (19) (23). Pearson's correlation analyses were conducted between the SDI and both crude and age-standardized rates of DALYs, prevalence, and incidence. The SDI influences disease burden through mechanisms such as financial access to healthcare, improved health literacy promoting preventive behaviors, and shifts in population age structure affecting chronic disease patterns.

Data analysis and quality

Disease burden estimates were presented as absolute values and age-standardized rates by cause, with 95% uncertainty intervals reflecting variability and modeling uncertainty, covering trends from 1990 to 2021 (24). The GBD modeling framework, including spatiotemporal Gaussian process regression, ensemble modeling, and Bayesian meta-regression (DisMod-MR 2.1), were used to address missing data. For countries with low population (e.g., Maldives, Bhutan), Bayesian hierarchical modeling and empirical Bayes shrinkage were applied to stabilize estimates. Age-standardized estimates enable comparisons over time and across countries and subregions by adjusting for differences in population age distribution (25).

Results

Burden of MSK and headache disorders in Asia, 2021

In 2021, MSK and headache disorders imposed a significant burden on Asia. Specifically, LBP (36 million) and migraine (25 million) were the disorders with the highest DALYs. RA was the only condition among these disorders that contributed to mortality, with 24,000 deaths accounting for 0.2% of all deaths in Asia. TTH exhibited the highest prevalence and incidence (410 million cases), followed by LBP (140 million cases) and migraine (53 million cases). Although TTH prevalence was 10-fold higher than that of migraine, its DALY burden was only approximately 1/10th that of migraine (eTable 1). LBP was the primary source of DALYs among MSK disorders, highlighting its substantial impact on the disease bur-

den across regions. Overall, MSK and headache disorders accounted for 119.97 million DALYs, representing 8.7% of total DALYs in Asia.

Changes in Burden, 1990–2021

From 1990 to 2021, the absolute burden of MSK and headache disorders increased in the Asian population despite a decrease in age-standardized rates. LBP remains the leading cause of DALYs in Asia, whereas RA alone was the leading cause of mortality (eTable 1). Since 1990, mortality and DALYs due to RA increased by 138% and 94%, respectively, although age-standardized mortality and DALY rates for RA have shifted by -3% and +3%, respectively, over the same period

Overall, the burden of MSK and headache disorders increased between 1990 and 2021. However, the age-standardized incidence, prevalence, and DALY rates of RA and LBP decreased during this period (eTable 1). Furthermore, four conditions—hand OA, hip OA, other MSK disorders, and gout—exhibited age-standardized DALY increments of >18% between 1990 and 2021, whereas that of NP remained steady (eTable 1).

Age and sex differences, 2021

As seen in Fig. 1 and 2, peak DALYs were observed at ages 50–54 years. RA peaked at 55–59 years; arthritis burden increased from age 35 years. LBP/NP peaked at 50–54 years. Gout increased in men aged ≥ 25 years; migraine peaked at 30–34 years, and TTH at 35–39 years. The overall DALYs was higher among women (male-to-female ratio: 0.64), except for hip OA (1.11), other OA (1.14), and gout DALYs (3.1), as the burden of these conditions was higher among men (eTable 2).

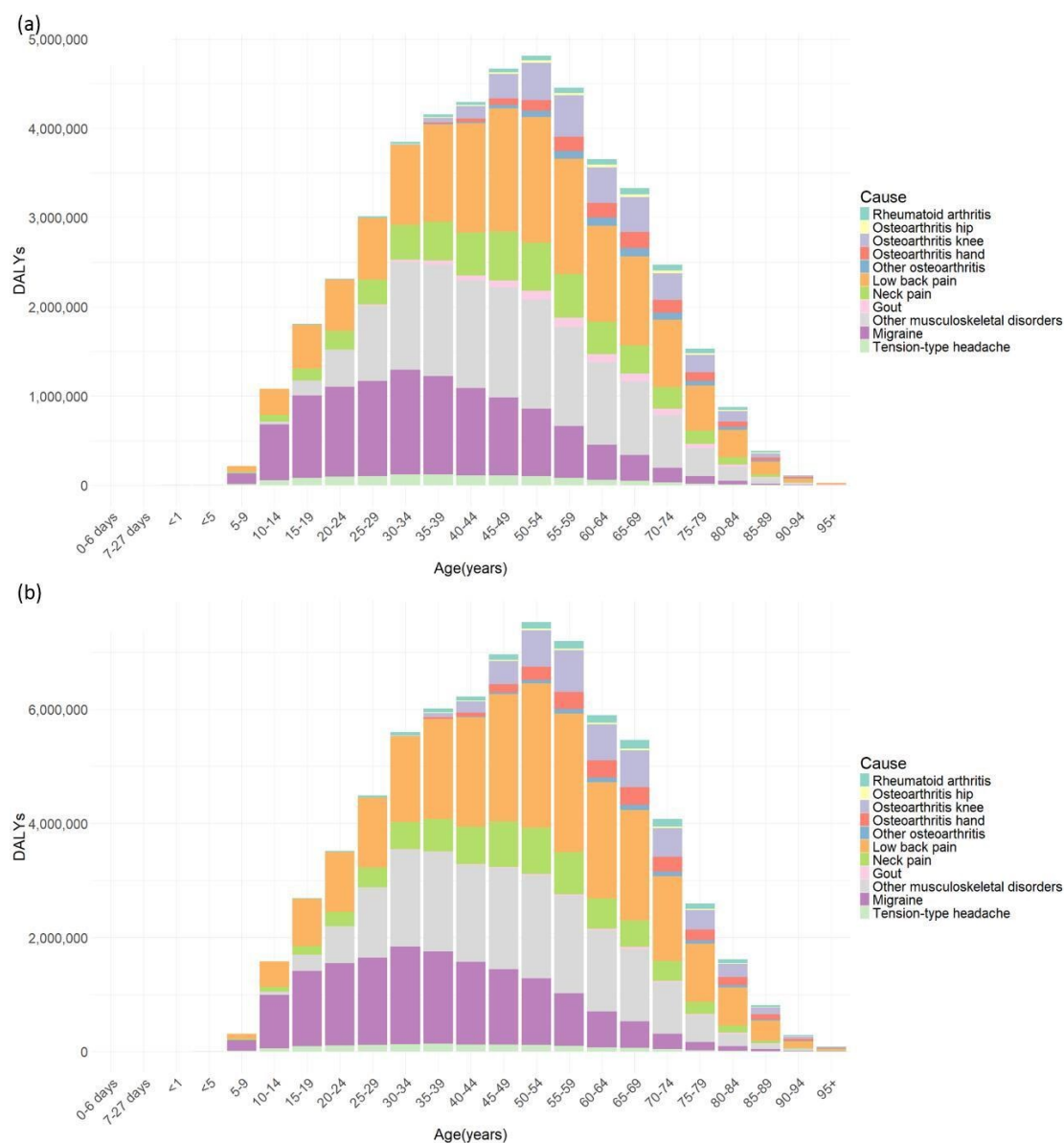


Fig. 1: Burden of musculoskeletal and headache disorders categorized by age for both sexes in Asia, 2021
(A) Disability-adjusted life years (DALYs) and (B) age-standardized DALY rates

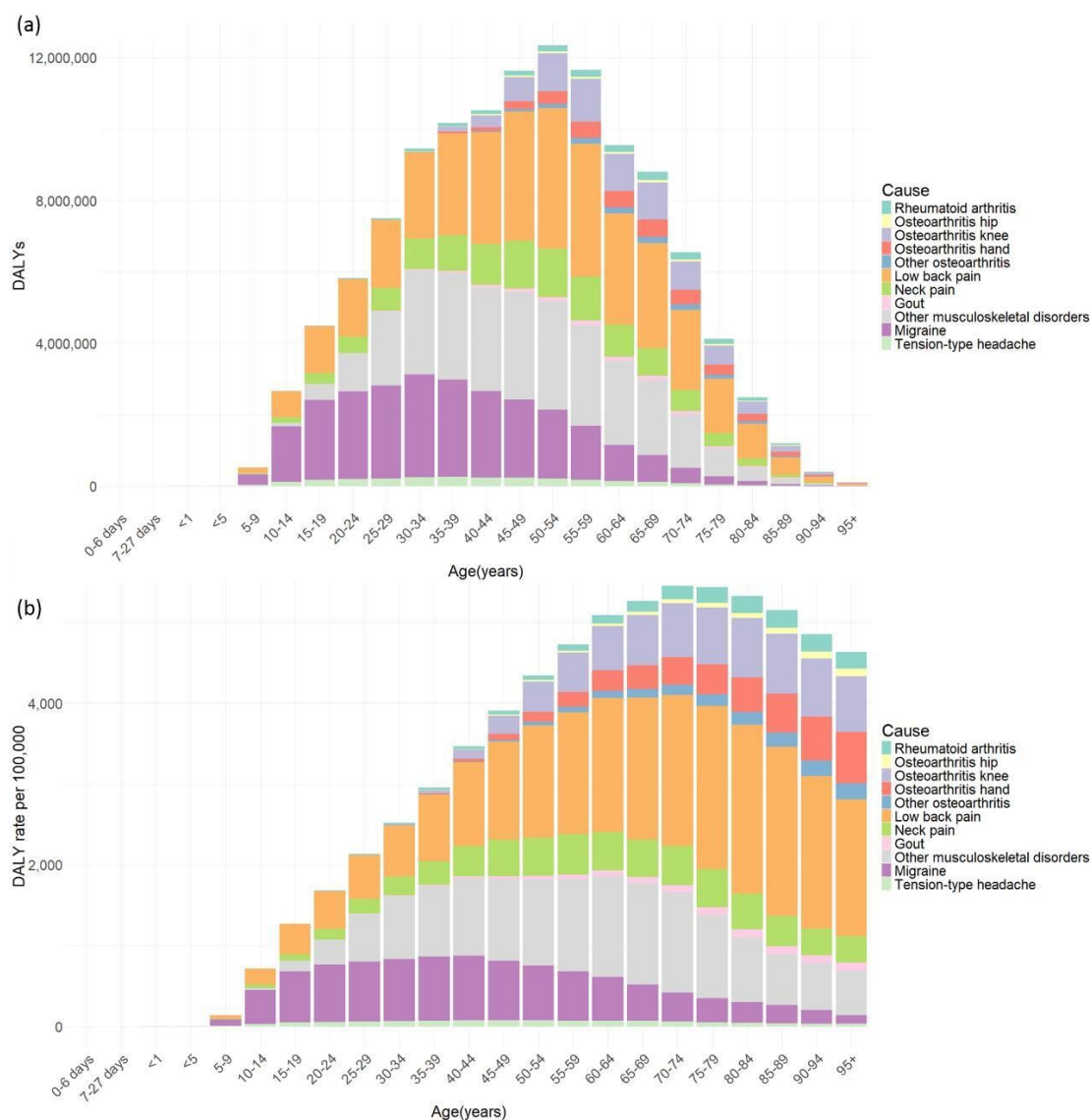


Fig. 2: (A) Disability-adjusted life years (DALYs) and (B) DALY rate per 100,000 for musculoskeletal and headache disorders by sex in Asia, 2021

Country-Specific Differences, 2021

Fig. 3 illustrates the variations in the age-standardized DALY rates for MSK and headache disorders across 49 Asian countries. LBP was the leading condition in most countries, but ranked third in Thailand. Overall, MSK and headache disorder DALYs increased in most countries since 1990 but remained stable in China, Israel, North Korea. RA rates fell almost everywhere except in Pakistan and Philippines. OA, gout, and other MSK disorder rates declined broadly; hip

OA rates increased only in North Korea. Knee OA rates declined, except for a slight reduction in South Korea. Only Singapore showed increasing hand OA rates. LBP prevalence was highest in East/Central Asia. Countries like Azerbaijan, Kuwait, Taiwan, Myanmar, Pakistan, Qatar, and Saudi Arabia showed rising LBP/NP trends. Headache disorder trends were largely stable (eTables 10-12,19-20).

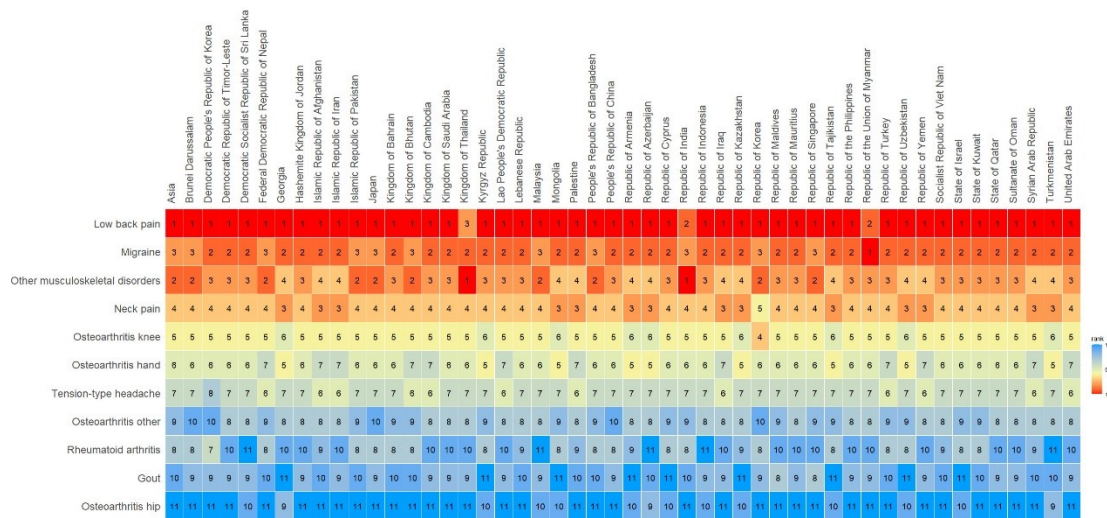


Fig. 3: Ranking of age-standardized disability-adjusted life year (DALY) rates for all musculoskeletal and headache disorders in Asian countries, 2021

Risk factors, 2021

Only OA, LBP, and gout had >10% of DALYs linked to specific risks (OA: high BMI [18.1%]; LBP: environmental, occupational, smoking risks; gout: metabolic (36.3%), high BMI [28.7%], impaired kidney function [10.3%]) (eTable 3).

SDI Correlations, 2021

LBP accounted for 37.2% of DALYs in high-SDI countries, with leading burdens in all SDI levels. NP was prominent in middle/high-middle-SDI countries, and hand OA, in middle-SDI countries. Overall, the SDI-DALY correlation was weak ($\gamma = 0.313$), although hip OA, NP, gout showed stronger positive associations ($\gamma > 0.6$). Migraine had a negative correlation, and TTH had a weak and positive correlation ($\gamma = 0.524$) (eTables 4-5).

Discussion

MSK and headache disorders have a substantial impact on DALYs in Asia. The GBD 2019 identified MSK disorders as being among the leading global contributors to DALYs (26), and the WHO Global Health Estimates similarly rank MSK disorders as major global health burdens,

with the figures in Asia making a substantial contribution (27). Notably, in 2021, TTH and migraine were recognized as major contributors to global DALYs, with Asia accounting for 119.97 million DALYs, representing 8.7% of the region's total DALYs (6). Among these conditions, arthritis was the most prevalent. This study, together with prior research, indicates a continuous upward trend in age-standardized DALYs, incidence, and prevalence of MSK and headache disorders in Asia since 1990 (2, 6).

Between 1990 and 2021, age-standardized DALYs for MSK and headache disorders increased slightly (e.g., RA +3%), while absolute DALYs increased markedly, with RA showing a 94% increase in DALYs and a 138% increase in deaths (eTables 3,11). These discrepancies likely reflect demographic shifts, including aging populations, improved diagnostics, expanded healthcare access, and enhanced accuracy in ICD-based cause-of-death reporting (28). For RA, although the absolute number of deaths increased by 138%, the age-standardized mortality rate remained stable. This discrepancy can be explained by demographic shifts, particularly the aging population in Asia, which led to an increase in the absolute number of RA cases without neces-

sarily increasing the disease's lethality (14). Furthermore, improvements in death certification and ICD coding practices over time have enhanced the accuracy of cause-of-death recording, partially accounting for the observed increase in reported RA-related deaths without a true increase in disease-specific mortality risk (29, 30). RA stands out as the only condition for which age-standardized DALYs and mortality rates have declined, likely due to the introduction of biologics, targeted synthetic disease-modifying antirheumatic drugs, earlier diagnosis, improved comorbidity management, and lifestyle improvements (31).

The burden profiles of MSK and headache disorders differ between Asia and Europe. In Asia, LBP, NP, and migraine dominate DALYs, with LBP accounting for 36 million DALYs and NP, for 23 million DALYs (Fig. 2, eTable 1). While LBP and migraine are also prominent in Europe, NP imposes a comparatively lower burden in that region (5). Our findings show that the peak DALY burden for MSK disorders in Asia occurs among individuals aged 50–54 years (Fig. 1), approximately a decade earlier than the peak in Europe (60s) (32), likely due to differences in population aging, environmental and economic factors, and healthcare access.

RA has shifted from the 7th highest DALY contributor in 1990 to the 11th in 2021 (Fig. 3). During the same period, both age-standardized DALYs and mortality rates for RA declined (eTables 3,11), reflecting the impact of therapeutic advances (33).

The substantial burden of LBP and NP has been attributed to general assumptions about physical labor as well as evidence from large-scale occupational health studies identifying heavy lifting, repetitive movements, and prolonged awkward postures as key risk factors (34, 35). In 2021, LBP accounted for 37.2% of DALYs in high-SDI countries and 37.7% in low-SDI countries (Fig. 4), confirming its global prevalence. NP affected approximately 230 million people worldwide in 2020, constituting a major cause of neurological disability (36) (37).

In East Asia, sedentary lifestyles in high-SDI countries likely contribute to high LBP prevalence, whereas in Central Asia, excessive physical activity related to agriculture, manufacturing, and construction may be driving the burden (eTable 17). Countries such as Azerbaijan, Kuwait, Taiwan, Myanmar, Pakistan, Qatar, and Saudi Arabia exhibited rising age-standardized DALY rates for LBP and NP, likely reflecting lifestyle changes due to rapid economic development, urbanization, occupational hazards, and limited public awareness of preventive practices (38).

Improvements in disease burden observed in low-SDI countries can be attributed to targeted public health initiatives, such as community-based rehabilitation programs in Nepal and India, enhancing primary care access for MSK management (39), and the expansion of headache clinics and awareness campaigns through international partnerships in countries like China and Pakistan (40, 41). These programs have contributed to earlier diagnosis, increased treatment access, and improved preventive care.

Between 1990 and 2021, gout showed reductions in age-standardized incidence, prevalence, and DALYs across Asia, likely reflecting successful public health interventions, increased health awareness, earlier diagnostic practices, and expanded pharmacological treatment options (42). While TTH was the most prevalent neurological disorder in Asia, migraine accounted for up to 10 times more DALYs, making it the second-largest contributor to DALYs among neurological conditions (6). Migraine prevalence peaked at age 35 years and was two-fold higher among women than among men. Remarkably, Myanmar showed the highest relative migraine burden among the analyzed conditions, potentially due to its younger population structure (Fig. 3).

Southeast Asia exhibited the lowest migraine prevalence, potentially due to the low frequency of migraine-associated genetic variants (43). However, China, reported by The Lancet GBD data (2016, 2019) to have the world's lowest age-standardized migraine prevalence (5), experienced one of the fastest increases in prevalence by 2021 in Asia.

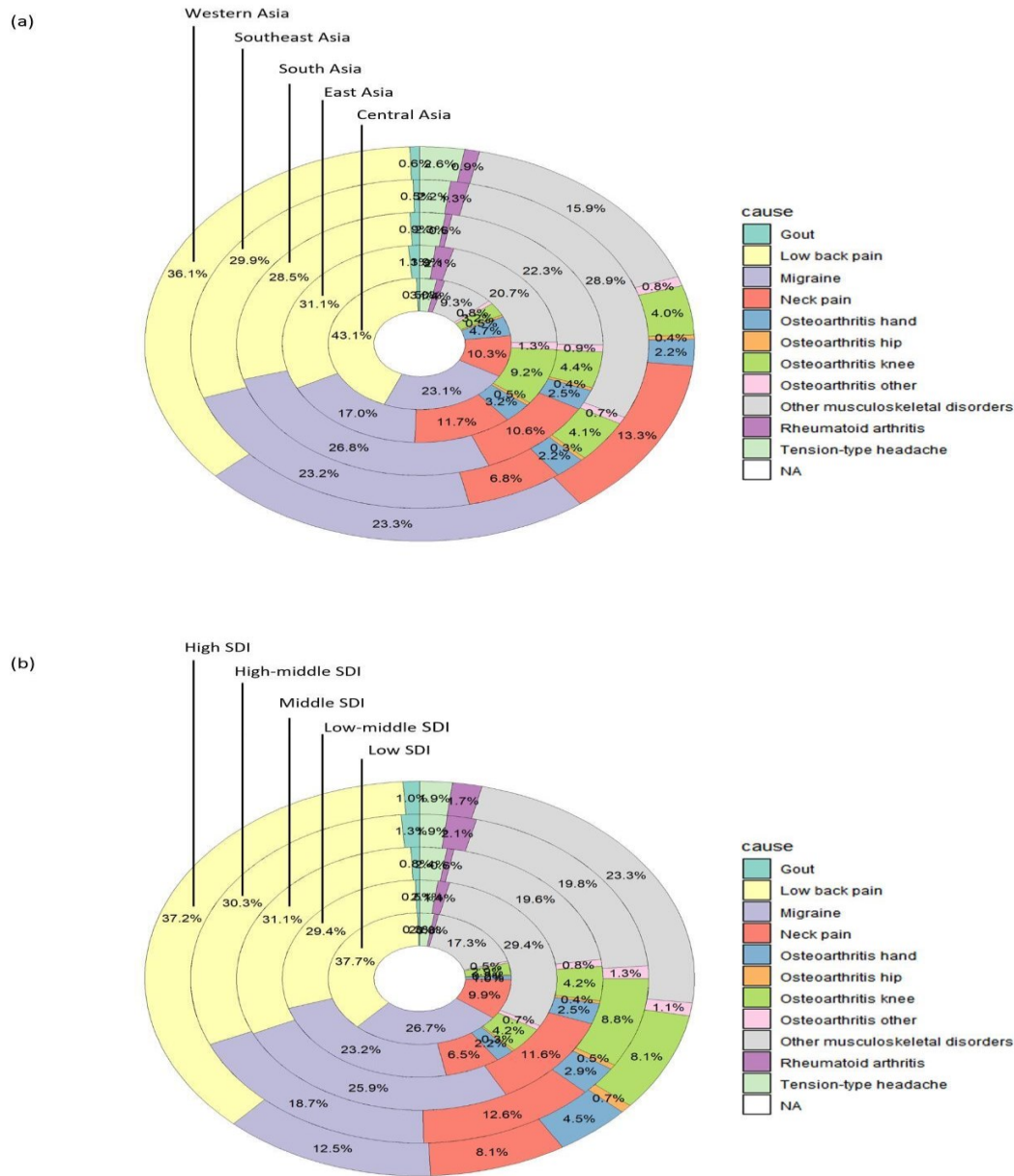


Fig. 4: Contribution of each disease to the overall burden of neurological disorders in Asia, 2019. Percentages represent the proportion of disability-adjusted life years (DALYs). (A) Different sub-regions. (B) Different sociodemographic index (SDI) levels

Most MSK and headache disorders show higher prevalence in women, likely due to factors such as reduced bone density, hormonal changes, and increased survival at older ages, which extend periods of disability (44). In contrast, hip and other osteoarthritis exhibited higher DALY bur-

dens in men, possibly linked to occupational strain, limited early detection, and disparities in health awareness, diverging from patterns observed in Western populations where women typically experience higher burden (44). Some studies have even reported no significant sex differ-

ences for hip and other OA DALYs in Western cohorts (44).

Low-SDI countries demonstrated greater improvements in MSK and headache disorder prevention and management than high-SDI countries (eTables 10-23). Even modest healthcare accessibility improvements in low-SDI countries can produce substantial impact. Notably, South and Southeast Asia face pronounced shortages of specialized physicians, underdeveloped treatment infrastructures, and inadequate public education on prevention and management, making preventive approaches especially critical.

Despite its comprehensive analysis, this study has limitations. First, data heterogeneity exists owing to varying cultural and sociodemographic factors across countries. Second, owing to data availability constraints, subnational analyses (e.g., within-country or regional comparisons) could not be included, which may have limited the precision of interregional comparisons within Asia.

Conclusion

By 2021, MSK and headache disorders were among the leading contributors to DALYs in Asia, with LBP, NP, and migraine identified as major pain-related conditions. As their burden is anticipated to rise alongside aging populations and developments in therapeutics, this study offers essential evidence to support targeted national and regional policies on prevention, treatment, and rehabilitation.

Ethics approval and consent to participate

This study was approved by the Armed Forces Medical Command (AFMC 2024-09-004). Informed consent was not required, as the analysis did not include identifiable information.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

This research was supported by SungKyunKwan University and the BK21 FOUR, funded by the Ministry of Education (MOE) and the National Research Foundation (NRF) of Korea. It is also supported by following NRF grants: NRF[2021R1-I1A2(059735)], RS[2024-0040(5650)], RS[2024-0044(0881)], and RS[2019-II19(0421)].

Availability of supplementary data

All supplementary data are accessible via sending email to the corresponding author based on reasonable application.

Competing interests

None

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