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The burden of migraine and tension-type headache in Asia from 1990 to 2021



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Abstract

Background In recent years, headache diseases have spread throughout the world, causing great suffering and even severe disability to patients, and increasing the burden on health care systems. However, studies of specific regions are rare. The purpose of our study is to comprehensively analyze the current situation and trends of headache diseases in Asia between 1990 and 2021, to provide details of headache diseases in Asia, and to provide scientific data to support health development strategies.

Methods Data from the Global Burden of Disease (GBD) 2021 database were used to calculate the incidence, prevalence and disability-adjusted life years (DALYs) of headache disorders in Asia from 1990 to 2021. Differences between years, ages, sexes and countries were also assessed, and we evaluated the correlation between epidemiological and sociodemographic indices (SDIs).

Result In 2021, there were approximately 683,514,637 cases of migraine in Asia. Meanwhile, there are now 1,130,221,326 cases associated with tension-type headache (TTH) in Asia. Specifically, the age-standardized DALYs (ASDR) [607 cases per 100,000 people (95% UI: 70 – 1,363)] for migraine were highest in Southeast Asia, and the ASDR [422 cases per 100,000 people (95% UI: 86–938)] was lowest in high-income countries of the Asia-Pacific region. ASDR [67 cases per 100,000 people (95% UI: 18–236)] was highest for TTH in Central Asia and lowest for ASDR [43 cases per 100,000 people (95% UI: 13–141)] in East Asia. In addition, women are the key population for migraine and TTH prevalence. In Asia, there were negative and positive correlations between migraine and TTH and SDI, respectively.

Conclusions Headache disorders pose a serious threat to the quality of life and safety of patients in Asia, increasing the burden on society, and this impact will continue to grow. Our findings suggest that active public awareness, improved guidelines, and better disease management are necessary to expand the public and healthcare system's attention to headache disorders, and thereby gain a greater advantage in combating the burden of headache disorders in the future.

Keywords Migraine, Tension-type headache, Disease burden, Asia

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Introduction

In 2018, the International Classification of Headache Disorders, 3rd edition (ICHD-3) [1], categorized primary headache disorders into four distinct subtypes: migraine, tension-type headache (TTH), trigeminal autonomic cephalalgias, and other primary headaches. These primary headaches are not only the most common form of headache but also a significant source of economic strain on society. Migraine, in particular, is a common and disabling neurovascular disorder marked by recurrent episodes of throbbing headaches, typically unilateral and of moderate to severe intensity. Accompanying symptoms often include photophobia, phonophobia, allodynia (increased sensitivity to pain), and gastrointestinal disturbances [2]. Studies suggest that approximately 70% of migraine sufferers experience at least one trigger before an attack, with emotional stress, physical exertion, and sleep disturbances being the most frequently reported [3]. Other potential triggers encompass environmental factors, dietary components, specific odors, confined spaces, and physical activity [4]. TTH, another prevalent neurological disorder, is characterized by mild to moderate pain, often described as a band-like sensation around the head. It is believed to result from the persistent contraction of head and neck muscles, which can be triggered by stress related to anxiety or depression, secondary pain symptoms, and poor posture [5, 6]. Relief from TTH can be achieved through adequate sleep, appropriate medication, maintaining correct posture, massage, and other therapeutic measures [5, 7].

Many epidemiological studies have documented the prevalence as well as the socioeconomic and personal impact of headache disorders [8]. In 2019, headache disorders are the 14th leading cause of disability adjusted life years (DALYs) worldwide [9], affecting both men and women of all ages. Among neurological disorders, migraine and TTH are also leading causes of DALYs in Asians [10]. In the Global Burden of Disease Study 2021 (GBD 2021), the global prevalence of migraine reached 1.16 billion cases, and the global prevalence of TTH was also high at 2.01 billion cases [11]. Migraine and TTH have a long duration, severe illness and poor prognosis, and although disease control can be achieved with appropriate medication, relapse and, in severe cases, disability continue to occur, placing a heavy burden on the patient, family and society.

Although there are several studies on global migraine and TTH trends, Asia has been less explored. Furthermore, with approximately 60% of the world's population [12], Asia is the most populous continent with a similarly heavy burden of headache disorders. However, to date, there are no global reports that have comprehensively delved into the epidemiology of headache disorders in Asia using the 2021 dataset. To address this gap, we retrieved the incidence, prevalence and DALYs trends of headache disorders in this population from 1990 to 2021 using the GBD database. The aim of our study was to comprehensively analyze the current status and trends of headache disorders in Asia between 1990 and 2021 in order to provide details of headache disorders in Asia and provide scientific data to support health development strategies.

Methods

Data sources

The data source for this study is the GBD 2021 database, a comprehensive collection of research on 371 diseases from 204 countries and territories [13]. All this data is freely available through the Global Health Data Exchange (https://ghdx.healthdata.org/gbd-2021/sources), and detailed information on the data, methodology and statistical modelling can be found in previous reports [14, 15]. The GBD draws on a wide range of data sources, including censuses, surveys, vital statistics and various health knowledge bases, while the GBD modelling uses a variety of statistical methods to synthesize this vast amount of data, ensuring reliability and accuracy [10, 11].

Disease introduction

According to GBD 2021 [16], migraine is defined as a disabling primary headache disorder characterized by recurrent moderate to severe throbbing unilateral headache. In GBD 2021, we did not distinguish between migraine with and without aura because most epidemiological studies reported only total migraine. A definite diagnosis of migraine was made if a patient's symptoms met al.l five major diagnostic criteria proposed by ICHD-3. Similarly, a definite diagnosis of TTH was made if the patient's symptoms met al.l five major diagnostic criteria of the ICHD-3. In this study, the International Classification of Diseases, 11th revision (ICD-11) codes for migraine and TTH were respectively 8A80 and 8A81.

Socio-demographic index (SDI)

The Socio-demographic Index (SDI) is a composite indicator introduced by the Institute for Health Metrics and Evaluation (IHME) in 2015 to assess the level of development of a country or region, emphasizing the link between social development and population health outcomes [17], and taking values between 0 and 1. Higher SDI values indicate higher levels of social development [18]. The world's 204 countries and territories are divided into five SDI regions: low SDI, medium-low SDI, medium SDI, medium-high SDI and high SDI.

Disease burden indicator

This study examined the trends in the prevalence, incidence, and disability-adjusted life years (DALYs) of migraine and TTH in Asia from 1990 to 2021. As the data used in this study were obtained from publicly available databases, ethical approval was not required. To ensure comprehensive geographical representation and methodological rigor, our study encompassed all 49 Asian countries and territories (including Taiwan, China) from the database. Additionally, we incorporated five Asian regions as defined by the GBD classification system: Central Asia, East Asia, South Asia, Southeast Asia, and the high-income Asia Pacific region. The term 'prevalence' is used to describe the actual number of cases occurring in a population due to a particular disease or injury. The term 'incidence' reflects the number of new cases of disease in a given period of time. And the term 'DALYs' describes the total healthy life years lost from morbidity to mortality. This includes both years of life lost due to premature death (YLL) and years of healthy life lost due to disease-induced disability (YLD) [19-21].

Statistical analysis of data

In this study, we employed a range of epidemiological indicators, including incidence, prevalence, DALYs and their corresponding age-standardized rates (ASRs), namely age-standardized prevalence rates (ASPR), agestandardized incidence rates (ASIR) and age-standardized DALYs (ASDR), to evaluate the burden of disease associated with migraine and TTH in Asian populations. As a consequence of the disparate age distributions and populations represented in the GBD data, ASRs served to eliminate the impact of variations in age distribution across countries, thereby ensuring consistency in the majority of rates. Additionally, the absolute number and incidence of migraine and TTH in distinct age groups across Asia and within individual Asian countries were evaluated, along with the prevalence, incidence, and male-to-female ratio of DALYs. To investigate the factors influencing changes in the burden of disease, Pearson correlation analyses were employed to calculate the relationship between regional and national ASRs and the SDI from 1990 to 2021. The analyses and graphical representations were conducted using R software (version 4.3.3) and GraphPad Prism software (version 10.1). The disease burden was estimated with a 95% uncertainty interval (UI). Two-tailed p-values less than 0.05 were considered statistically significant.

Result

Asia region

Table 1 indicates that there were 683,514,637 existing cases (95% UI: 588,712,926-783,557,934), 53,426,109 new cases (95% UI: 47,047,320-60,254,845), while the estimated number of DALYs attributed to migraine was 25,423,330 (95% UI: 3,640,434-56,079,665). Meanwhile, in Asia, the number of existing TTH cases was

1,130,221,326 (95% UI: 995,417,622-1,276,320,398), while the number of new cases was 407,550,589 (95% UI: 356,389,424–456,097,160). Furthermore, 2,497,175 DALYs (95% UI: 716,704-8,412,915) were associated with TTH.

For migraine in Asian 2021, the ASPR was 14,014 cases per 100,000 people (95% UI: 12,017-16,106), the ASIR was 1,162 cases per 100,000 people (95% UI: 1,022-1,309), and the ASDR per 100,000 people was 520 (95% UI: 72-1,149). When compared to the data from 1990, the annual change in the three aforementioned indicators was found to be 5.8%, 4.76%, and 5.65%, respectively. Southeast Asia had the highest ASPR [16,181 cases per 100,000 people (95% UI: 13,890-18,730)], ASIR [1,313 cases per 100,000 people (95% UI: 1,145-1,494)] and ASDR [607 cases per 100,000 people (95% UI: 70-1,363)]. In contrast, high-income Asia Pacific region exhibited the lowest ASPR [11,073 per population 100,000 (95% UI: 9,484-12,800)], ASIR [890 cases per 100,000 population (95% UI: 775-1,020)], and ASDR [422 cases per 100,000 people (95% UI: 86-938) in Asia.

For TTH in Asian 2021, the ASPR was 23,410 cases per 100,000 people (95% UI: 20,627 - 26,395), the ASIR was 8,559 cases per 100,000 people (95% UI: 7,463-9,588), and the ASDR per 100,000 people was 50 (95% UI: 14-173). When compared to the data from 1990, the annual change in the three aforementioned indicators was found to be 4.68%, 4.76%, and 5.65%, respectively. Central Asia had the highest ASPR [30,275 cases per 100,000 people (95% UI: 26,184-34,529)], ASIR [10,666 cases per 100,000 people (95% UI: 9,176-12,079)] and ASDR [67 cases per 100,000 people (95% UI: 18-236)]. On the contrary, East Asia exhibited the lowest ASPR [18,490 per population 100,000 (95% UI: 16,321-20,929)], ASIR [6,840 cases per 100,000 population (95% UI: 5,944-7,714)], and ASDR [43 cases per 100,000 people (95% UI: 13-141) in Asia.

Age and sex

The prevalence, incidence, and DALYs of migraine in Asia in 2021 exhibited a significant gender disparity, with women consistently experiencing higher rates across all age groups. Conversely, the prevalence, incidence, and DALYs of TTH showed a slight predominance among women compared to men at all ages.

With regard to prevalence rates, the age range at which migraine reached its highest occurrence was 40–44 years for women and 35–39 years for men (Fig. 1a, Table S1). The peak prevalence rates of TTH were observed in the age group of 30–34 for both genders (Fig. 1d, Table S4). In terms of incidence, the highest rates of migraine were observed in the 10–14 age group for both males and females (Fig. 1b, Table S2), while the highest rates of TTH

in Asia									
Migraine	Prevalence (95% UI)			Incidence (95% UI)			DALYs (95% UI)		
Location	Number	ASPR	Change rate of ASPR (%)	Number	ASIR	Change rate of ASIR (%)	Number	ASDR	Change rate of ASDR (%)
Asia	683,514,637 (588,712,926-783,557,934)	14,014 (12,017-16,106)	5.8 (3.71-7.51)	53,426,109 (47,047,320-60,254,845)	1,162 (1,022-1,309)	4.76 (3.48-5.93)	25,423,330 (3,640,434-56,079,665)	520 (72-1,149)	5.65 (0.23-7.95)
Central	13240,030	13,584	-0.5	1,061,285	1,098	-0.46	494,679	507	-0.5
Asia	(11,217,466-15,557,584)	(11,539-15,918)	(-0.580.43)	(899,936-1,224,759)	(933-1,278)	(-0.520.41)	(87,858-1,116,618)	(90-1,145)	(-2.06-0.79)
East Asia	191,704,024	11,798	7.32	13,524,743	977 (863-1,104)	6.06 (2.99-9.05)	7,248,392	444	7.18
	(166,846,938-221,713,279)	(10,162-13,567)	(3.49-11.03)	(12,000,700-15,250,401)			(1,171,603-15,744,802)	(67-972)	(-0.26-11.11)
South Asia	286,372,320 (743 859 319-378 165 148)	14,860 (1.2.704-16.954)	0.39 (-2.64-3.3)	24,072,217 (21.074567-27.098809)	1,231 (1.080-1.385)	0.18 (-1 87-2 27)	10,362,369 (1 252 047-23 272 971)	538 (68-1 198)	0.66 (-2 93-3 86)
Southeast	119.860.813	16.181	-2.01	9.375.683	1.313	-0.88	4.504.043	607	-1.64
Asia	(103,266,386-139,236,439)	(13,890-18,730)	(-2.841.26)	(8,147,718-10,607,424)	(1,145-1,494)	(-1.320.39)	(522,076-10,047,421)	(70-1,363)	(-3.04-0.73)
High-in-	21,172,927	11,073	0.71 (-2.62-4.1)	1,286,379	890 (775-1,020)	0.75 (-1.87-3.5)	827,640	422	0.63
come Asia	(18,371,952-24,296,846)	(9,484-12,800)		(1,129,143-1,464,113)			(204,646-1,773,190)	(86-938)	(-2.91-3.86)
	Drevtalence (05% 111)			Incidence (05% 111)					
Location	Number	ASPR	Change rate of ASPR (%)	Number	ASIR	Change rate of ASIR (%)	Number	ASDR	Change rate of ASDR (%)
Asia	1,130,221,326	23,410	4.68 (3.46-5.94)	407,550,589	8,559	4.04 (3.01-5.07)	2,497,175	50	с
	(995,417,622-1,276,320,398)	(20,627-26,395)		(356,389,424-456,097,160)	(7,463-9,588)		(716,704-8,412,915)	(14-173)	(-2.93-12.26)
Central	29,097,630	30,275	-0.05	10,234,975	10,666	-0.04	64,831 (17,776-228,394)	67	-0.09
Asia	(25,144,968-33,291,691)	(26,184-34,529)	(-0.25-0.15)	(8,758,645-11,625,088)	(9,176-12,079)	(-0.25-0.15)		(18-236)	(-5.06-3.85)
East Asia	293,499,972	18,490	7.57 (3.84-11.7)	105,511,251	6,840	5.71 (2.92-8.9)	740,187	43	3.98
	(259,912,832-331,480,659)	(16,321-20,929)		(91,966,527-118,962,755)	(5,944-7,714)		(232,175-2,249,350)	(13-141)	(-3.24-18.52)
South Asia	483,244,865	25,405	0.06	177,579,939	9,331	0.07	954,549	51	0.41
	(423,704,615-550,135,164)	(22,430-28,583)	(-0.12-0.21)	(155,107,997-200,066,872)	(8,146-10,414)	(-0.09-0.22)	(250,693-3,465,829)	(14-180)	(-5.83-7.33)
Southeast	183,412,193	25,257	0.07	65,088,157	9,054	0.16	377,303	51	0.82
Asia	(159,923,056-207,823,000)	(22,085-28,547)	(-0.18-0.33)	(56,779,820-73,575,586)	(7,870-10,170)	(-0.06-0.36)	(103,759-1,323,331)	(14-181)	(-4.4-6.05)
High-in-	60,741,994	29,868	0.74 (-1.8-3.54)	20,382,957	10,575	-0.61	139,920 (40,610-440,967)	64	0.31
come Asia	(54,074,165-67,510,419)	(26,437-33,549)		(17,860,857-22,678,667)	(9,239-11,885)	(-2.71-1.79)		(17-217)	(-4.4-5.23)
Pacific									
Abbreviation DALYs rate	s: DALYs = disability-adjusted life ye	ears, TTH = tension-typ	e headache, Ul = u	ncertainty interval, ASIR = age	standardized incid	ence rate, ASPR = a	ge-standardized prevalence	rate, ASDR = a	ige-standardized

rates of age-standardized rates (1990-2021) of prevalence, incidence, and dalvs of migraine and ΠH annial change rates (2021) Londordized 000 numbers (2021) L T



Fig. 1 The absolute numbers and rates of prevalence, incidence, and DALYs of migraine (**a-c**) and TTH (**d-f**) by gender and age in Asia in 2021. DALYs = disability-adjusted life years, TTH = tension-type headache, UI = uncertainty interval



Fig. 2 The ratios of male to female in prevalence, incidence, and DALYs of migraine (**a-c**) and TTH (**d-f**) in Asia in 1990 and 2021. DALYs = disabilityadjusted life years, TTH = tension-type headache

were observed in the 95 + age group for both genders, followed by the 25–29 age group (Fig. 1e, Table S5). Regarding DALYs, women experienced a peak rate for migraine in the 45–49 age group, whereas men experienced it in the 40–44 age group (Fig. 1c, Table S3). The rate for TTH also exhibited a peak in the 40–44 age group for both genders (Fig. 1f, Table S6). The numbers of disease burden were similar to the trend of increase and decrease described above.

The prevalence, incidence, and DALYs ratios for headache disorders between males and females in the Asian region have remained consistent with those observed in 1990 (Fig. 2a-f, Table S7-8). However, a subtle shift in the ratio for migraine has been noted. Notably, a decline in gender-related disparities was observed among individuals under 39 and 75–79 years of age, while a marginal increase was evident among those aged 45–69 and 85+years.

National and regional levels

Among the Asian regions in 2021, Cyprus had the highest ASPR for migraine [17,623 cases per 100,000 population (95% UI: 14,999–20,771)] and Singapore had the lowest [9,471 cases per 100,000 population (95% UI:

8,034–11,042)] (Fig. 3a, Table S9). Meanwhile, the ASPR of TTH in Cyprus was the highest [32,412 cases per 100,000 population (95% UI: 28,254–37,015)] and those in Taiwan (Province of China) was the lowest [17,558 cases per 100,000 population (95% UI: 14,915-20515)] (Fig. 3e, Table S10). In addition, from 1990 to 2021, the annual percentage change in ASPR for migraine ranged from 3.71 to 7.51%. The change of maximum and minimum countries was Singapore [13.89% (95% UI: 4.31-23.77%)] and Thailand [-8.56% (95% UI: -13.3%--3.41%)]. From 1990 to 2021, the annual percentage change in TTH's ASPR ranged from 3.46 to 5.94%. The change of maximum and minimum countries was Singapore [8.31% (95% UI: -1.42-19.73%)] and Nepal [-1.08% (95% UI: -5.03%-3.1%)] (Table 1, S9-10).

In terms of incidence, migraine had the highest ASIR in Cyprus and Israel [1,370 cases per 100,000 population (95% UI: 1,164-1,578)] and the lowest in Singapore [804 cases per 100,000 population (95% UI: 671–947)] (Fig. 3b, Table S9). Meanwhile, TTH in Cyprus had the highest ASIR [11,001 cases per 100,000 population (95%UI: 9,453–12,467)] and in Taiwan (Province of China) had the lowest ASIR [6542 cases per 100,000 population (95%UI: 5702–7448)] (Fig. 3e, Table S10). In addition, from 1990 to 2021, the annual percentage change in ASIR for migraine ranged from 3.48 to 5.93%. Singapore migraine ASIR maximum change [11.71% (UI: 95–4.03)]

-20.01%], Thailand's migraine ASIR change minimum [3.35% (95% UI: -6.6% - 0.62%)]. From 1990 to 2021, the annual percentage change in ASIR for TTH ranged from 3.01 to 5.07%. China TTH ASIR maximally changed 5.93% (95% UI: 3.04 -9.25%), Japan's TTH ASIR change minimum [0.98% (95% UI: -3.69% - 1.93%)] (Table 1, S9-10).

In terms of DALY, migraine had the highest ASDR in Cyprus and Israel [657 cases per 100,000 population (95% UI: 94-1,443)] and the lowest in Singapore [370 cases per 100,000 population (95% UI: 671-823)] (Fig. 3c, Table S9). Meanwhile, Iran TTH had the highest ASDR [75 cases per 100,000 population (95% UI: 24-227)] and Taiwan (Province of China) had the lowest [41 cases per 100,000 population (95% UI: 12-134)] (Fig. 3f, Table S10). In addition, from 1990 to 2021, the annual percentage change in ASDR for migraine ranged from 0.23 to 7.95%. Among them, Singapore and Thailand migraine ASDR change respectively the biggest [11.39% (95% UI: -1.5 -20.06%)] and the minimum [8.07% (UI: 95% -14.28% -3.73%)]. From 1990 to 2021, the annual percentage change in ASDR for TTH ranged from -2.93 to 12.26%. Singapore and Pakistan TTH of ASDR change respectively the biggest [4.3% (95% UI: -10.71 - 19.15%)] and the minimum [7.56% (95% UI: -24.01% -4.26%)] (Table 1, <u>S9-10</u>).



Fig. 3 The ASPR, ASIR and ASDR of migraine (a-c) and TTH (d-f) in Asian countries and regions. ASPR=age-standardized prevalence rate, ASIR=age-standardized DALYs rate, DALYs=disability-adjusted life years, TTH=tension-type headache

Relationship between headache burden and SDI

The analysis of migraine prevalence, incidence, and DALYs rates in Asia revealed a noteworthy trend: these metrics were inversely correlated with the SDI (Fig. 4a-c, Table S11). This relationship was particularly pronounced at an SDI threshold of 0.6, beyond which a marked reduction in migraine-related disease burden was observed as SDI values increase. This suggested that as economic conditions and societal development improve, the burden of migraine tended to diminish among Asian populations.

In stark contrast, the prevalence, incidence, and DALYs rates of TTH exhibited a positive correlation with the SDI level (Fig. 4d-f, Table S12). The overall disease burden of TTH was found to escalate significantly alongside rising SDI values. This observation indicated that as economic prosperity and societal well-being improve, there was a corresponding increase in the burden of TTH, which was in direct opposition to the trend observed for migraine.

Compare with other regions

This comprehensive study spanned both global and five distinct SDI regions, aiming to elucidate the disparities in headache burden across various geographical and socioeconomic settings. Longitudinal analysis revealed relative stability in the headache-related disease burden across all regions during the study period, with minor fluctuations characterized by slight increases or decreases in specific metrics. The results indicated that across all metrics the burden of migraine and TTH in Asia was considerably lower than the global average (Fig. 5a-f, Table S13-S18).

However, a more nuanced comparison with other regions revealed that while the ASDR for migraine in Asia was only higher than that of regions with low SDI, both the ASPR and ASIR for migraine were higher than those in regions with medium-high SDI as well as low SDI. Conversely, the burden of TTH in Asia was found to be relatively low in comparison to other regions. Although the ASPR for TTH in Asia exceeded that of the medium SDI region, and the ASIR was higher than both medium and low SDI regions, the ASDR remained the lowest across all regions. This indicates that while the incidence of TTH may be relatively high in Asia, the associated disability is comparatively lower, which could be attributed to various factors including healthcare access, treatment efficacy, and cultural differences in reporting disability.

It is particularly noteworthy that East Asia and the high-income Asia Pacific regions have demonstrated substantially lower ASPR, ASIR, and ASDR for migraine, suggesting a significant reduction in the disease burden in these areas. South-East Asia has shown significantly higher ASPR, ASIR, and ASDR for migraine when compared to both the global average and other regions. And the elevated ASIR observed in South Asia further underscores the high disease burden in this region. Additionally, East Asia has also demonstrated considerably lower ASPR, ASIR, and ASDR for TTH, implying a reduced burden within this particular region.

Discussion

To date, the literature lacks complete disease analyses of migraine and TTH in the Asian region. We hope that this study will update the burden of migraine and TTH and inform policy makers to help identify best practices for headache prevention and control worldwide and more specifically in the Asian region. This study is the first to examine the burden of migraine and TTH in an Asian population from 1990 to 2021. It comprehensively analyses the impact of migraine and TTH by region, sex, age



Fig. 4 The associations between SDI and the disease burden of migraine (a-c) and TTH (d-f) in Asia. SDI = socio-demographic index, ASPR = age-standardized prevalence rate, ASIR = age-standardized incidence rate, ASDR = age-standardized DALYs rate, DALYs = disability-adjusted life years, TTH = tensiontype headache



Fig. 5 The differences of prevalence (a-b), incidence (c-d), and DALYs (e-f) of migraine and TTH between Asia. SDI=socio-demographic index, ASPR=age-standardized prevalence rate, ASIR=age-standardized incidence rate, ASDR=age-standardized DALYs rate, DALYs=disability-adjusted life years, TTH=tension-type headache

and SDI using data from GBD 2021 to provide data to support the response to the high risk of headache in Asia.

The current work found that in 2021 there will be 683,514,637 cases of migraine and 1,130,221,326 cases of TTH in Asia. TTH is more common and more frequent than migraine, but migraine is significantly more disabling. The disease burden of migraine and TTH in Asia has increased every year since 1990. This may be partly due to the population explosion, with the total world population increasing by 31% in 32 years and Asia being the most populous continent, and partly due to increased awareness, with more headache disorders being recognized and diagnosed [22, 23].

Headache disorders place a greater burden on Asian women, while TTH affects a relatively younger population. Studies showed that the onset of headache was concentrated in adolescents, but the peak of the disease was in middle-aged adults, and more DALYs were caused 5–10 years after the peak of the disease, suggesting that migraine and TTH started at a young age, were difficult to treat and developed into a chronic disease that affected the patient's quality of life within a short period of time, suggesting that the impact of headache disorders on patients can be lifelong and rapid. In terms of age, young people represented a new burden of headache, which may be related to factors such as schooling and rapid physical and mental development. Notably, the study revealed that the incidence of TTH among the Asian population reached its zenith within the 95 years and older age cohort. We hypothesize that this peak may be attributed to the limited size of the population sample in this age group. Our analysis revealed notable gender

disparities in headache disease burden across specific age cohorts. A pronounced increase in gender differences was observed in the 45-69 and 85+age groups, with women experiencing a more substantial escalation in headache disease burden compared to their male counterparts. The elevated burden among women aged 45-69 may be attributable to menopausal hormonal fluctuations, which have been well-documented as a significant risk factor for headache disorders in this demographic group [24]. Furthermore, some studies have shown that women live longer than men [25], which may lead to a slight increase in the gender difference after the age of 85. Despite a general trend of narrowing gender disparities in headache prevalence across most age groups compared to historical data from three decades ago, several critical observations warrant attention. First, the femaleto-male prevalence ratio remains below 1 across all age groups. Second, the rate of disparity reduction has been relatively modest. These persistent patterns underscore the continued disproportionate burden of headache disorders borne by women, suggesting that gender remains a crucial determinant in headache epidemiology. Previous epidemiological studies showed significant gender differences in the prevalence of headache disorders, with women being three times more likely to be affected than men [26, 27]. Physical and psychological differences between men and women may contribute to the higher prevalence in women. The unstable hormone levels that persist during menstruation, pregnancy and menopause are among the most likely reasons for the differences [24, 28]. In addition, as Asian women take on more roles in society, working and caring for their families require high levels of intensity and motivation to cope, and women are more sensitive and tolerant to stress and pain than men, all of which make women more susceptible to headache disorders [29]. Existing gender stereotypes have also had a negative impact on women's stress, with headache disorders even being defined as 'women's disorders' [30]. It is clear that headache in Asia can be better prevented or managed through proactive policies and better targeting of health resources to populations with higher prevalence.

Regionally, the burden of migraine and TTH is currently higher in eastern and central Asia. There is almost a twofold difference in the burden of disease between countries. The ASPR, ASIP and ASDR for migraine and TTH in Asia are significantly lower than global levels. Just for Asia as a whole, the burden of headache disease has been growing positively for more than three decades. Cyprus and Israel are recognized as having the highest headache burden in Asia. Cyprus and Israel's healthcare systems are among the most advanced in the world, with a high level of awareness of headache disorders, ensuring the early identification and diagnosis of diseases in the population. Thailand indeed carries a significant headache burden, yet it is noteworthy for its rapid decline, a trend that may be attributed to the nation's enhanced healthcare and health infrastructure. This improvement is reflected in the 2021 Global Healthcare Index by CEO World magazine, where Thailand is ranked 13th in overall health factors [31, 32]. These developments in healthcare provision and financing have likely contributed to better management and reduction of the headache burden. The incidence of headache disorders and the risk of disability are most significant in China. It may be because China is currently in a new stage of comprehensive poverty alleviation, and the large gap in economic development and medical security across the country has exacerbated the work pressure and life pressure of the population. In obvious contrast, Taiwan, China, has the lowest burden of TTH disease due to its stable economic level and better medical security system. Nepal, which has been plagued by Corona Virus Disease 2019 (COVID-19) and dengue outbreaks in recent years, and Pakistan's political chaos may reduce the health sector's attention to headache disorders, so ASPR and ASDR have changed the least. Ongoing surveillance of these patterns is crucial for elucidating the factors that contribute to headache disorders, thereby enabling the development of optimal strategies for the prevention and management of headaches in Asia.

Additionally, our findings revealed a negative correlation between the burden of migraine and SDI, with a notable decline in prevalence as SDI increased. Conversely, the burden of TTH demonstrated a significant positive correlation with SDI. The observed trends in the prevalence, incidence and DALYs of TTH in Asian populations in this study challenge the prevailing assumptions about SDI-related disease burden. It can be reasonably assumed that higher SDI levels indicate a more robust healthcare system and higher-quality healthcare, which in turn is associated with a reduced disease burden, including that of migraine. With regard to TTH, while higher SDI levels have resulted in greater healthcare coverage for the population, rapid urbanization and industrialization have precipitated transformative shifts in lifestyle, encompassing sedentary habits, stress, a paucity of physical activity, overuse of medications and electronic devices, and deteriorating sleep patterns. These factors have served to exacerbate the disease.

The findings of this study have significant implications for the delivery of healthcare services, as primary headache disorders, including migraine and TTH, represent a leading cause of disability on a global scale. It is imperative that primary headache care be integrated into global health systems, as such integration is regarded as an efficacious and sustainable approach. This could facilitate the identification of patients at risk and reinforce the implementation of prevention and treatment strategies with the objective of reducing the disease burden. Furthermore, it would facilitate comprehensive data collection on migraine and tension headaches. Previous research has demonstrated that patients with headaches often fail to adhere to prescribed preventive medications [33]. However, the implementation of patient education programmers based on defined protocols may enhance adherence.

Limitation

This study on the burden of disease for headache focused exclusively on migraine and TTH, excluding other headache types. Furthermore, all studies were based on data from the GBD study, rather than utilizing raw data. In the section of the study that analyzed countries and regions according to the GBD classification, only 34 countries and regions in high-income countries in Central Asia, East Asia, South Asia, South-East Asia, and Asia-Pacific were included. However, there are 48 countries in Asia, and in comparison, countries in West Asia were not included. The countries and regions were not included in the study due to the fact that West Asian countries are included in the GBD classification as a region of North Africa. Between the years 1990 and 2021, the diagnostic criteria for migraine and TTH were undergoing changes that could lead to potential biases. Additionally, although the Asian region was the focus of our study, the collection of data on migraine and TTH may have been incomplete due to differences in culture, resources, and infrastructure. These factors could have contributed to the inaccuracy of our data measurements. It is important to note that these potential biases may affect our conclusions, but they are a result of measurement inaccuracies or inherent methodological biases, rather than real differences. the burden of disease in West Asia has been reduced due to migraine and TTH, as evidenced by the use of raw data.

Conclusion

In summary, the most populous continent, Asia, is afflicted by a high prevalence of headache disorders. Middle-aged individuals, particularly women, are the primary sufferers of headaches, and the incurable and recurrent nature of these conditions causes significant distress. In 2021, Asia recorded an estimated 683,514,637 migraine cases and 1,130,221,326 TTH cases. Analysis of epidemiological trends revealed a consistent annual increase of approximately 5% in disease burden indicators since 1990. Geographically, East and Central Asia exhibited particularly high disease burdens for both migraine and TTH. Furthermore, significant disparities in disease burden distribution were observed across different countries, highlighting substantial regional variations in headache-related health impacts. Therefore, the prevention and treatment of migraine and TTH is of paramount societal importance to the Asian population, and there is an urgent need for increased investment in healthcare resources for vulnerable populations to slow the progression of headache disorders.

Abbreviations

ICHD-3 the International Classification of Headache Disorders, 3rd edition

TTH	Tension-Type Headache
DALYs	Disability-Adjusted Life Years
GBD	Global Burden of Disease
DALYs	Disability-Adjusted Life Years
SDI	Socio-Demographic Index
ASRs	Age-Standardized Rates
ASIR	Age-Standardized Incidence Rate
ASPR	Age-Standardized Prevalence Rate
ASDR	Age-Standardized DALYs Rate
UL	Uncertainty Intervals

UI Uncertainty Intervals

Supplementary Information

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Supplementary Material 1

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Author contributions

YZZ: formal analysis, visualization, writing– original draft; HZ: writing - review & editing, project administration; YJY: visualization; QP: methodology; JW: supervision, writing - review & editing, funding acquisition. All authors reviewed the manuscript.

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Data availability

GBD study 2021 data resources were available online from the Global Health Data Exchange (GHDx) query tool (https://vizhub.healthdata.org/gbd-results).

Declarations

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Competing interests

The authors declare no competing interests.

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