Global, regional, and national burden of headache disorders, 1990–2023: a systematic analysis for the Global Burden of Disease Study 2023

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Summary

Background The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2023 estimates health loss from migraine, tension-type headache, and medication-overuse headache. This study presents updated results on headache-attributed burden from 1990 to 2023, along with clinical and public health implications.

Methods Data on the prevalence, incidence, or remission of migraine, tension-type headache, and medication-overuse headache were extracted from published population-based studies. We used hierarchical Bayesian meta-regression modelling to estimate global, regional, and country-level prevalence of headache disorders. For the first time in GBD 2023, age-specific and sex-specific estimates of time in symptomatic state were applied by meta-analysing individual participant data from 41653 individuals from the general populations of 18 countries from all parts of the world. Disability weights were applied to calculate years lived with disability (YLDs). Since medication-overuse headache is a sequela of a mistreated primary headache (due to medication overuse), its burden was reattributed to migraine or tension-type headache, informed by a meta-analysis of three longitudinal studies.

Findings In 2023, 2·9 billion individuals (95% uncertainty interval 2·6–3·1) were affected by headache disorders, with a global age-standardised prevalence of 34·6% (31·6–37·5) and a YLD rate of 541·9 (373·4–739·9) per 100000 population, with 487·5 (323·0–678·8) per 100000 population attributed to migraine. The prevalence rates of these headache disorders have remained stable over the past three decades. YLD rates due to headache disorders were more than twice as high in females (739·9 [511·2–1011·5] per 100000) as in males (346·1 [240·4–481·8] per 100000). Medication-overuse headache contributed 58·9% of the YLD estimates for tension-type headache in males and 56·1% in females, as well as 22·6% of the YLD estimates for migraines in males and 14·1% in females.

Interpretation Headache disorders, in particular migraine, continue to be a major global health challenge, emphasising the need for effective management and prevention strategies. Much headache-attributed burden could be averted or eliminated by avoiding overuse of medication (including over-the-counter medication), underscoring the importance of public education.

Funding Gates Foundation.

Introduction

Headache disorders are among the most prevalent disorders worldwide.[1–3] In the past two decades, they have also been recognised as being among the leading causes of health loss.[2–4] Currently, the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) produces estimates for migraine, tension-type headache, and medication-overuse headache—the most common headache types with greatest impacts on population health.[5]

Since there are no diagnostic biomarkers, the diagnoses of these three headache types are based on clinical criteria described in the International Classification of Headache Disorders (ICHD;[6] panel). The reliance on self-reported symptoms is diagnostically challenging and highly dependent on the doctor–patient interaction; in epidemiological enquiry, with no such interaction, the challenges are greater, and uncertainties inevitable.

Migraine and tension-type headache are identified through the presence or absence, respectively, of the same set of clinical characteristics, with migraine almost invariably being more bothersome than tension-type headache (eg, experiencing nausea, an associated symptom of migraine but not of tension-type headache, is more bothersome than not experiencing nausea). A definite diagnosis of migraine or tension-type headache is made when all criteria A–E for the diagnosis are fulfilled. Notably, the ICHD allows for a probable diagnosis when all but one of criteria A–D are fulfilled.[6] In a clinical setting, a probable diagnosis is often later confirmed as definite.

Unlike migraine and tension-type headache, medication-overuse headache does not develop de novo, but is a sequela of a primary headache (in virtually all cases, migraine or tension-type headache)[7] brought on

Research in context

Evidence before this study
We searched PubMed to identify studies addressing global headache burden between Jan 1, 1990, and Jan 1, 2025, using the following search string: (headache[Title/Abstract]) AND (burden[Title/Abstract] OR health loss[Title/Abstract] OR disability[Title/Abstract]) AND ((global[Title/Abstract]) OR (international[Title/Abstract])). We found that studies mainly looked at small geographical areas (commonly single countries), focused solely on prevalence without any attempt to address health loss, or used results from the Global Burden of Disease, Injuries, and Risk Factors Study (GBD). The Global Campaign against Headache is one effort that stands out from this, consistently gathering data on prevalence and headache-attributed burden across the world. This campaign has resulted in numerous country-specific publications on the burden of headache disorders, which has informed GBD's headache models. Since migraine was included in GBD in 2000, headache disorders have been ranked among the top causes of health loss. Later, estimates for tension-type headache and medication-overuse headache have been added, the latter as a sequela of mistreated migraine or tension-type headache. Health loss has been especially high among young adults and females owing to the high prevalence of migraine. Evidence exists that females have longer headache episodes than males, but previous GBD rounds have not accounted for this.

Added value of this study
This study provides improved insight into the burden of headache disorders by incorporating more granular estimates of time in symptomatic state for migraine and tension-type headache in GBD. This was achieved by analysing a large amount of population-representative individual participant data, allowing separate estimates by age and sex. Compared with previous GBD rounds, this approach reduced the uncertainty of the health loss estimates and revealed greater sex differences, health loss among females (739·9 years lived with disability [YLDs] per 100 000 population) being more than double the health loss among males (346·1 YLDs per 100 000). This study also indicated that these health losses would be greatly reduced by avoiding acute medication overconsumption, since more than 50% of health loss attributed to tension-type headache and more than 15% attributed to migraine (>20% to all headache) was actually due to medication-overuse headache.

Implications of all the available evidence
Headache disorders continue to be among the most prevalent disorders globally and migraine among the most disabling. Females have more than twice the burden of males, owing not only to a higher prevalence of migraine but also to the fact that, at an individual level, they spend more time with headache. Improved coverage of effective headache medications (including preventive treatments) is needed, but this must be done in tandem with education on the correct use of acute medications to avoid the increased burden associated with their overconsumption.

by over-frequent consumption of acute medication. By definition, medication-overuse headache is present on at least 15 days per month.[6]

The health loss caused by headache disorders is especially high among young adults and females, in both cases owing to a high prevalence of migraine. Previous iterations of GBD have, however, not accounted for the fact that females have longer-duration attacks than males.[8] This study presents novel methods implemented in GBD 2023 to account for age and sex differences in time spent with headache, and uses these to present updated estimates of headache-attributed burden from 1990 to 2023, along with the clinical and public health implications.

This manuscript was produced as part of the GBD Collaborator Network and in accordance with the GBD protocol.[9]

Methods

Overview

We give here an overview of the methods relevant for estimating the burden of headache disorders. Details can be found in appendix 1 (pp 3–17).

In the GBD hierarchy of diseases and injuries, headache disorders are a Level 3 cause, under neurological disorders (Level 2) and non-communicable diseases (Level 1). At Level 4, the most granular Level, headache disorders include migraine and tension-type headache. Since medication-overuse headache is a sequela of a pre-existing primary headache, its burden is wholly reattributed to migraine or tension-type headache in a ratio informed by a meta-analysis of three prospective longitudinal studies reporting the proportions of medication-overuse headache origin: 73·2% (95% uncertainty interval [UI] 63·7–81·0) for migraine and 26·8% (19·0–36·3) for tension-type headache.[10–12]

The case definitions for migraine, tension-type headache, and medication-overuse headache in GBD are based on the diagnostic criteria (appendix 1 pp 3–4). Separate models for definite and probable diagnoses exist, which are combined to give overall estimates of migraine and tension-type headache.

In GBD, disease burden is expressed as disability-adjusted life-years (DALYs), which are calculated as the sum of years of life lost (YLLs) to premature death and years lived with disability (YLDs).[13] Since GBD does not estimate any deaths from headache disorders, DALYs are equivalent to YLDs for headache disorders. YLDs are calculated for each headache type by multiplying 1-year

Migraine

(A) At least five attacks fulfilling criteria B–D

(B) Lasting 4–72 h

(C) At least two of the following four characteristics:

    (1) unilateral location

    (2) pulsating quality

    (3) moderate or severe pain intensity

    (4) aggravation by or causing avoidance of routine physical activity

(D) At least one of the following:

    (1) nausea and/or vomiting

    (2) photophobia and phonophobia

(E) Not better accounted for by another ICHD-3 diagnosis

Tension-type headache

(A) At least ten attacks fulfilling criteria B–D

(B) Lasting 30 min to 7 days

(C) At least two of the following four characteristics:

    (1) bilateral location

    (2) pressing (non-pulsating) quality

    (3) mild or moderate pain intensity

    (4) not aggravated by routine physical activity

(D) Both of the following:

    (1) no nausea or vomiting

    (2) no more than one of photophobia or phonophobia

(E) Not better accounted for by another ICHD-3 diagnosis

Medication-overuse headache

(A) Headache occurring on ≥15 days per month in a patient with a pre-existing headache disorder

(B) Regular overuse for >3 months of one or more drugs that can be taken for acute and/or symptomatic treatment of headache

(C) Not better accounted for by another ICHD-3 diagnosis

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prevalence by proportion of time in symptomatic state and the associated disability weight (quantifying the health loss experienced while in a symptomatic state).

Data sources

The input data informing GBD models were based on published population-based studies. The PubMed search strings used for systematic reviews are shown in appendix 1 (pp 4–5). Only studies reporting on the prevalence, incidence, or remission of migraine (definite or probable), tension-type headache (definite or probable), or medication-overuse headache were included.

The last systematic review informing GBD headache models was carried out in 2017. Data on migraine were extracted from 182 sources from 64 countries and 18 GBD regions, and on tension-type headache from 125 sources from 49 countries and 17 GBD regions. For medication-overuse headache, data were extracted from 47 sources from 30 countries and ten GBD regions. The vast majority of data (94·9%) related to prevalence. Western Europe had substantially more data sources than any of the other regions for each headache type, and data on definite migraine were the most abundant compared with the other headache diagnoses. Detailed information on data sources is available in appendix 1 (pp 5–11).

Data standardisation

Extracted data were divided by age and sex where necessary. When studies reported prevalence for all sexes combined, estimates were divided by generating and applying a global sex ratio using the meta-regression—Bayesian, regularized, trimmed (MR-BRT) tool.[14] Furthermore, when studies reported prevalence

across large age groups, these were divided across 5-year age bins according to the global age pattern of prevalence modelled by a hierarchical Bayesian meta-regression modelling tool, DisMod-MR 2.1.[13]

To mitigate the influence of studies with low methodological quality and potential bias, we evaluated data for systematic differences and corrected accordingly using MR-BRT (appendix 1 pp 11–12). The following eight quality criteria for headache epidemiological studies were considered:[5] representativeness of the population of interest; sampling quality; recall period; participation rate; survey method; validation of diagnostic instrument; diagnostic criteria; headache type (definite or probable) assumed. Detailed information on data standardisation is available in appendix 1 (pp 11–12).

Estimation of prevalence

We used DisMod-MR 2.1 to estimate the prevalences of migraine, tension-type headache, and medication-overuse headache from 1990 to 2023, globally, regionally, and for individual countries. Estimates could be obtained in countries and regions where no primary studies were published using a geographical cascade where model fits were sequentially passed down as priors to the next geographical level (eg, super-region to region, region to country). In each model, it was assumed that there was no incidence before 5 years of age and that there was no mortality from headache disorders. No risk factors were used to inform prevalence estimation.

Time in symptomatic state

In GBD 2023, we updated estimates of time in symptomatic state for migraine and tension-type

	Health state description	Disability weight (95% UI)
Migraine	Has severe, throbbing head pain and nausea that cause great difficulty in daily activities and sometimes confine the person to bed. Moving around, light, and noise make it worse.	0·441 (0·294–0·588)
Tension-type headache	Has a moderate headache that also affects the neck, which causes difficulty in daily activities.	0·037 (0·022–0·057)
Medication-overuse headache	Has daily headaches, felt as dull pain and often lasting all day, with poor sleep, nausea, and fatigue. The person takes medicine for the headaches, which provides little relief but is needed to avoid having worse symptoms.	0·223 (0·146–0·313)
UI=uncertainty interval.		

Table 1: Disability weights for headache disorders modelled in GBD[16,17]

	Males	Females
Definite migraine		
<35 years	6·34% (5·48–7·20)	9·30% (8·53–10·06)
35–49 years	7·86% (6·74–8·98)	10·13% (9·29–10·96)
≥50 years	8·67% (6·96–10·38)	12·77% (11·37–14·18)
Probable migraine		
<35 years	3·60% (2·94–4·26)	5·65% (4·96–6·33)
35–49 years	3·36% (2·78–3·94)	5·19% (4·53–5·84)
≥50 years	6·04% (4·50–7·58)	7·16% (6·07–8·25)
Definite tension-type headache		
<35 years	2·61% (2·30–2·92)	3·98% (3·57–4·39)
35–49 years	2·48% (2·13–2·83)	3·59% (3·16–4·02)
≥50 years	3·55% (2·98–4·12)	4·57% (3·92–5·21)
Probable tension-type headache		
<35 years	1·39% (0·93–1·85)	1·88% (1·42–2·34)
35–49 years	0·99% (0·75–1·23)	2·15% (1·42–2·88)
≥50 years	2·44% (1·30–3·58)	3·56% (1·89–5·23)

Data represent the mean percentage of time in a year in which a person is experiencing headache. Values in parentheses are 95% uncertainty intervals.

Table 2: Estimates of mean time in symptomatic state for migraine and tension-type headache, by sex and age

headache, defined as the proportion of time during which a person has a headache.

Using the HARDSHIP (Headache-Attributed Restriction, Disability, Social Handicap and Impaired Participation) adult database,[15] an individual participant data meta-analysis was performed among 41 653 individuals (19 590 males) aged 18–65 years from the general populations of 18 countries representing all seven GBD super-regions. In all contributing surveys, participants reported the number of days with headache during the preceding month or year and usual duration (hours) of their headache episodes. At the individual level, reported headache frequency was multiplied by reported usual duration of episodes to yield time in symptomatic state, and expressed as a proportion of all time.

Mean times in symptomatic state were thereby extracted for definite migraine, probable migraine, definite tension-type headache, and probable tension-type headache. Since time in symptomatic state varied across age and differed between males and females, age-specific and sex-specific estimates were made. As a trade-off between granularity and statistical power, and to reflect the age pattern, three age bins (<35 years, 35–49 years, and ≥50 years) were applied.

For medication-overuse headache, the same estimate of 53·2% time in symptomatic state as in previous iterations (based on a meta-analysis; appendix 1 p 16) was applied before reattribution to migraine (38·9% [28·4–49·4]) and tension-type headache (14·3% [7·0–21·6]) in the proportions stated earlier.

Disability weights

All disability weights in GBD were determined through surveys of the general population and the use of lay descriptions of health states.[16,17] These weights range from 0 (indicating no health loss) to 1 (a health loss equivalent to being dead). The lay descriptions and corresponding disability weights of migraine, tension-type headache, and medication-overuse headache are shown in table 1. On average, during an attack, people with migraine have a health loss of 44·1% compared with people of full health. The equivalent values are 3·7% for tension-type headache and 22·3% for medication-overuse headache.

Presentation of results

The 95% UIs of YLDs were propagated from the 95% UIs of prevalence, time in symptomatic state, and disability weight estimates. These were derived from 250 samples from each estimate, using the 2·5th and 97·5th percentile values of the 250 values to determine the upper and lower bounds. After YLDs were estimated, an adjustment was made to account for comorbidity between all diseases in GBD.[13]

Age-standardised rates were estimated using the GBD standard population.[13]

Analyses were done in R (version 4.2.2).

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

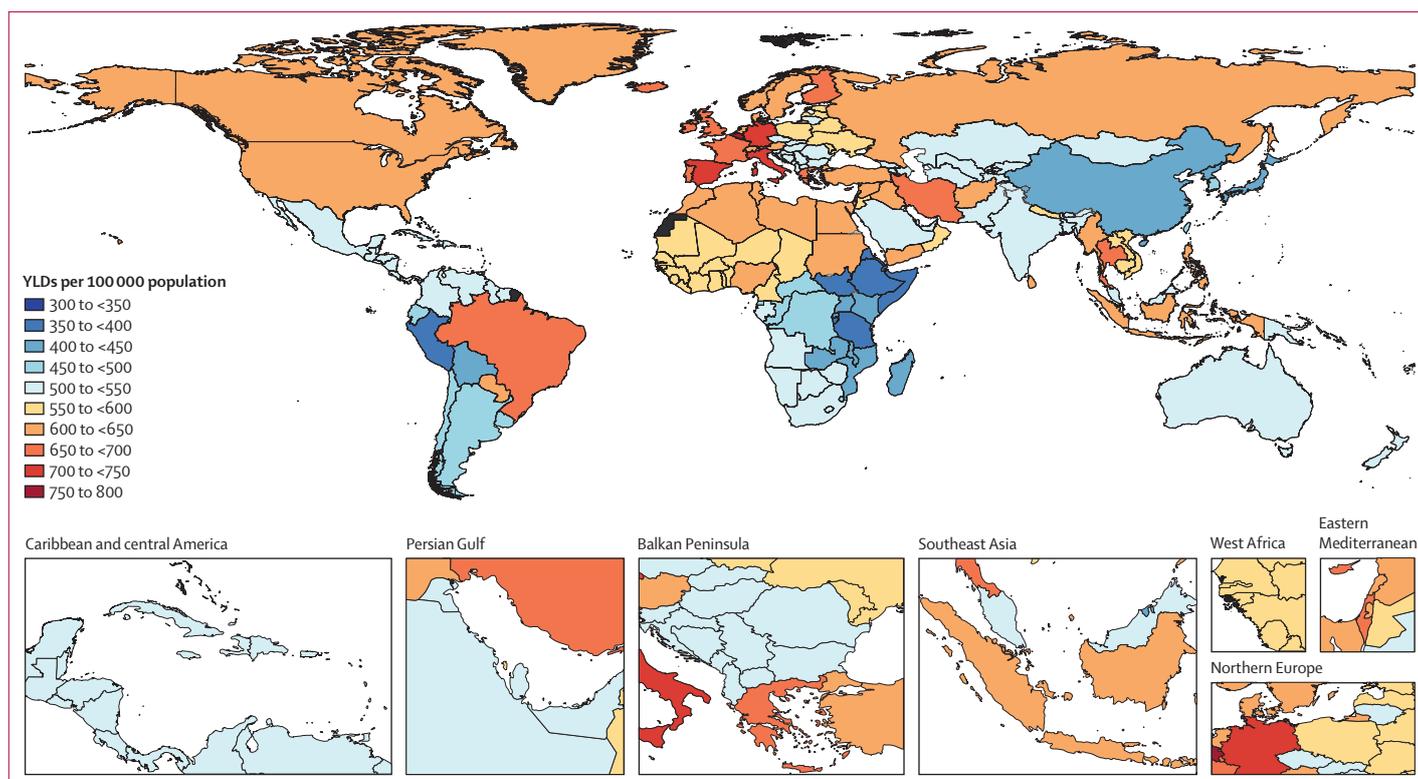Table 2 shows the age-specific and sex-specific time in symptomatic state estimates for migraine and

Figure 1: **Age-standardised YLD rates due to headache disorders, by country, all sexes, 2023**
YLDs=years lived with disability.

tension-type headache. Females consistently spent more time with headache across all age groups and case definitions than males. For definite migraine, time in symptomatic state increased steadily with age—in males ranging from 6·34% (95% UI 5·48–7·20) in those younger than 35 years to 8·67% (6·96–10·38) in those aged 50 years or older, and in females from 9·30% (8·53–10·06) in those younger than 35 years to 12·77% (11·37–14·18) in those aged 50 years or older. For both probable migraine and definite tension-type headache, time in symptomatic state was considerably lower than that for definite migraine, was similar in those younger than 35 years and those aged 35–49 years, increasing in those aged 50 years or older. Probable tension-type headache was associated with the least time in symptomatic state, but this also peaked in those aged 50 years or older.

In 2023, 2·9 billion individuals (2·6–3·1) were estimated to have a headache disorder, equating to a global age-standardised prevalence of 34·6% (31·6–37·5), which was higher among females (37·5% [34·4–40·4]) than males (31·8% [28·9–34·8]). The global YLD count was 45·5 million (31·4–62·0), equating to an age-standardised rate of 541·9 YLDs (373·4–739·9) per 100 000 population, over twice as high among females (739·9 YLDs [511·2–1011·5] per 100 000) as among males (346·1 YLDs [240·4–481·8] per 100 000). A map of

age-standardised YLDs attributed to headache disorders is shown in figure 1.

Tension-type headache was more common than migraine with a global age-standardised prevalence of 24·9% (22·0–28·2), which was relatively similar between males (24·4% [21·6–27·6]) and females (25·5% [22·4–28·7]). The global age-standardised prevalence of migraine was 14·1% (12·1–15·9), and was significantly higher among females (17·6% [15·2–19·9]) than males (10·5% [9·0–12·1]).

In 2023, migraine alone caused 40·9 million (27·1–56·9) YLDs. In terms of age-standardised YLD rates, migraine ranked eighth among all conditions, with a rate of 487·5 YLDs (323·0–678·8) per 100 000. In 1990, migraine ranked fifth, with a similar rate of 481·6 YLDs (319·6–668·5) per 100 000. For tension-type headache, the respective rates were 54·4 YLDs (36·7–77·3) per 100 000 in 2023 and 55·5 YLDs (37·6–79·0) per 100 000 in 1990.

Table 3 shows age-standardised estimates of prevalence and YLDs for migraine and tension-type headache in 1990 and 2023 for seven GBD super-regions and globally. The equivalent country-specific estimates are shown in appendix 1 (pp 17–31). The north Africa and Middle East super-region had the highest age-standardised YLD rate for migraine in 2023 (552·8 YLDs [366·5–757·9] per 100 000 population), closely followed by the high-income super-region (538·7 YLDs [358·6–748·4]

	Prevalence per 100 000 population		YLDs per 100 000 population	
	1990	2023	1990	2023
Migraine				
Global	13 817 (11 925–15 630)	14 053 (12 067–15 881)	481·6 (319·6–668·5)	487·5 (323·0–678·8)
Central Europe, eastern Europe, and central Asia	13 691 (11 785–15 571)	13 624 (11 687–15 500)	498·8 (326·9–686·7)	493·8 (323·3–677·6)
High income	15 588 (13 505–17 689)	15 553 (13 384–17 586)	543·5 (358·7–752·2)	538·7 (358·6–748·4)
Latin America and Caribbean	14 797 (12 635–16 806)	14 818 (12 600–16 807)	511·6 (343·6–706·0)	511·1 (341·5–704·7)
North Africa and Middle East	15 090 (12 912–17 382)	15 157 (13 103–17 359)	552·3 (365·9–763·3)	552·8 (366·5–757·9)
South Asia	14 606 (12 619–16 739)	14 611 (12 587–16 633)	484·3 (327·1–671·5)	487·8 (324·1–684·3)
Southeast Asia, east Asia, and Oceania	12 136 (10 450–13 732)	12 977 (11 190–14 700)	424·9 (285·0–594·1)	455·1 (300·9–633·0)
Sub-Saharan Africa	12 892 (10 968–14 734)	12 987 (11 053–14 886)	444·7 (293·5–617·9)	450·8 (299·5–623·9)
Tension-type headache				
Global	25 060 (22 168–28 223)	24 940 (21 975–28 157)	55·5 (37·6–79·0)	54·4 (36·7–77·3)
Central Europe, eastern Europe, and central Asia	31 434 (27 797–35 248)	31 450 (27 749–35 393)	84·1 (56·3–120·7)	82·9 (55·7–118·9)
High income	32 241 (28 708–36 399)	31 985 (28 353–35 954)	67·8 (46·7–96·2)	67·5 (46·4–96·2)
Latin America and Caribbean	25 821 (22 799–29 061)	25 650 (22 609–29 089)	51·7 (34·9–73·5)	52·0 (35·1–73·7)
North Africa and Middle East	23 777 (20 529–27 186)	23 979 (20 765–27 289)	66·4 (43·6–97·5)	66·9 (44·0–97·4)
South Asia	25 979 (23 078–29 288)	25 991 (23 077–29 267)	50·2 (34·0–70·8)	50·8 (34·3–71·7)
Southeast Asia, east Asia, and Oceania	19 330 (17 045–21 799)	20 849 (18 309–23 506)	41·9 (28·2–60·1)	43·9 (29·6–62·9)
Sub-Saharan Africa	22 842 (19 842–25 916)	22 746 (19 761–25 792)	51·8 (34·6–75·3)	52·3 (34·9–75·9)

Values in parentheses are 95% uncertainty intervals. YLD=years lived with disability.

Table 3: Age-standardised prevalence and YLD rates attributed to migraine and tension-type headache globally and by super-region, 1990 and 2023
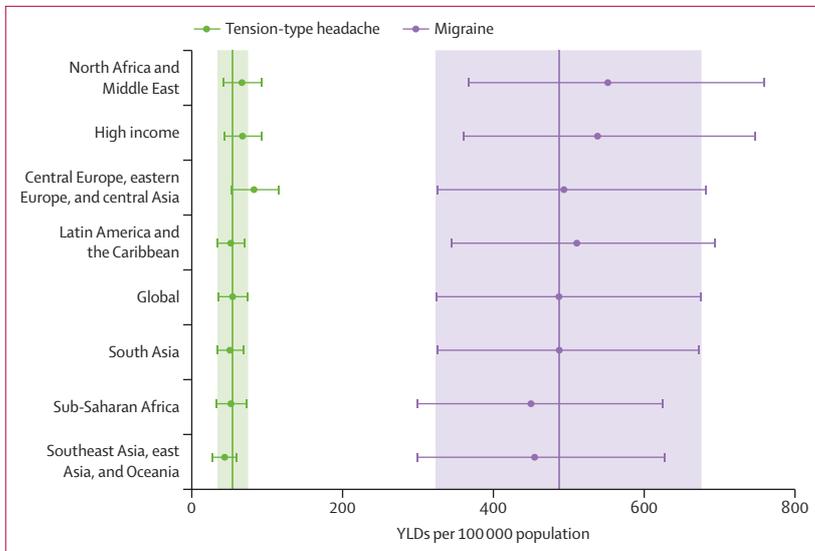
Figure 2: Age-standardised rate of YLDs attributed to migraine and tension-type headache globally and by super-region, 2023
Points and error bars represent means and 95% uncertainty intervals. Vertical lines show the mean global estimates and shaded areas are global 95% uncertainty intervals. YLDs=years lived with disability.

per 100 000). Central Europe, eastern Europe, and central Asia had the highest age-standardised YLD rate for tension-type headache (82·9 YLDs [55·7–118·9] per 100 000). The lowest rate for migraine was found in sub-Saharan Africa (450·8 YLDs [299·5–623·9] per 100 000), and for tension-type headache the lowest rate was in southeast Asia, east Asia, and Oceania (43·9 YLDs

[29·6–62·9] per 100 000). There was a high degree of overlap between the 95% UIs of the different GBD super-regions, and, for migraine, the estimates for all regions were placed well within the 95% UI of the global estimate (figure 2).

There were minimal changes in age-standardised YLD rates for both migraine and tension-type headache between 1990 and 2023 (figure 3).

For migraine, medication-overuse headache contributed 6·0% of the prevalence estimates for males and 5·0% for females, but 22·6% of the YLD estimates for males and 14·1% for females. For tension-type headache, medication-overuse headache contributed only 0·9% of the prevalence estimates for males and 1·3% for females, but 58·9% and 56·1% of the YLD estimates, respectively. Hence, 20·8% of headache-attributed YLDs came from medication-overuse headache.

Details of how the underlying headache diagnoses (definite diagnosis, probable diagnosis, and medication-overuse headache) contributed to age-standardised prevalence and YLD rates can be found in appendix 1 (pp 31–33).

Discussion

Headache disorders continue to be among the most prevalent and burdensome conditions worldwide, as evidenced by the 2·9 billion individuals affected in 2023. The notable age-standardised rate of 541·9 YLDs per 100 000 population positions headache disorders as the sixth most disabling group of conditions worldwide.[13] Our findings highlight the pressing need for effective

management and prevention strategies for headache disorders.

Despite that, tension-type headache was almost twice as prevalent as migraine (24·9% *vs* 14·1%), migraine accounted for 90% of YLDs attributed to headache disorders in 2023. This was because of the substantially higher disability weight for migraine (0·441 *vs* 0·037),[16] a reflection of the more severe symptoms associated with migraine episodes than with tension-type headache episodes.[6] Notably, these disability weights do not currently differentiate between probable and definite diagnoses. Mostly, individuals are diagnosed with probable rather than definite migraine because attack duration either falls short of or exceeds the 4–72 h specified in the diagnostic criteria,[18,19] which is already factored into the time in symptomatic state estimates. Nonetheless, a proportion of individuals with probable migraine—those who fulfil the duration criterion—should probably be assigned a lower disability weight, since, by not fulfilling another criterion (and thereby falling short of meeting criteria for definite migraine), they are likely to have fewer debilitating symptoms (eg, nausea or vomiting). Conversely, a proportion of individuals with probable tension-type headache should probably be assigned a higher disability weight, for the converse reason (ie, by not fulfilling one diagnostic criterion of tension-type headache, they have at least one migraine-like symptom, such as nausea or vomiting).

It should be emphasised that, within the scheme of the ICHD diagnostic criteria, "probable" diagnoses represent probable cases of migraine or tension-type headache; they do not recognise "probable migraine" and "probable tension-type headache" as entities distinct from "definite migraine" or "definite tension-type headache" (terms that are not used in the ICHD). The diagnostic criteria of ICHD[6] prioritise specificity over sensitivity because their primary intent is uniformity of meaning in research.[20] In clinical settings, probable diagnoses can be applied tentatively, with follow-up allowing for confirmation or rejection in the course of management. Such confirmation or rejection is not possible in cross-sectional epidemiological studies, which are the predominant source of data on prevalence and attributable burden.

More YLDs are attributed to migraine also because individuals with migraine spend a considerably greater proportion of their time with headache than do those with tension-type headache (table 2). The incorporation of age-specific and sex-specific estimates of time in symptomatic state represents a methodological refinement in GBD 2023. In previous GBD iterations, estimates of time in symptomatic state were based on a meta-analysis of 19 surveys (n=29 062, age 18–65 years), of which three surveys were of clinical samples and another three were of samples from patient organisations. By contrast, the new estimates were derived from high-quality population-representative individual participant data (n=41 653). This new meta-analysis greatly reduced
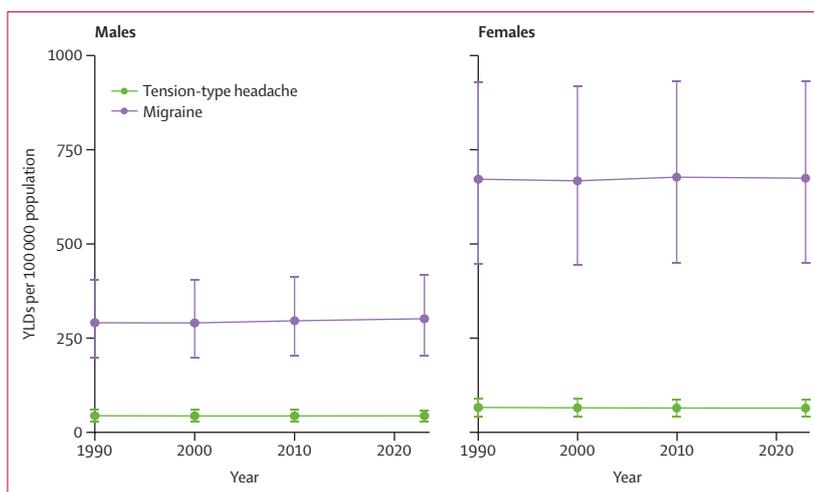
Figure 3: Global age-standardised rates of YLDs attributed to migraine and tension-type headache, by sex, 1990–2023
Points and error bars represent means and 95% uncertainty intervals. YLDs=years lived with disability.

uncertainty in the YLD estimates (the 95% UIs of global age-standardised YLDs per 100 000 population was 117·6–1245·4 in GBD 2021[2] and 373·4–739·9 in GBD 2023), and increased the evident difference in YLDs between females (739·9 [511·2–1011·5] per 100 000) and males (346·1 [240·4–481·8] per 100 000). Also of interest was the positive association between age and time in symptomatic state, especially for definite migraine (not to be confused with the inverted U-shaped relationship between age and prevalence). The reason for this association is not clear. One explanation could be that those who are most severely affected (longest headache duration or highest frequency) are least likely to go into remission, such that the mean individual time in symptomatic state is greater among older people with migraine. In support of this, chronic migraine is reportedly more likely than episodic migraine to persist into later life.[21]

Of profound clinical relevance, and implication for public health, was the very substantial burden attributed to medication-overuse headache. Our findings indicate that more than 20% of headache-attributed burden would be mitigated or completely averted if an important minority of people with headache did not overuse medication. This underpins the need to raise awareness, among both people with headache and health-care providers, about the risks associated with the overuse of acute medication. The studies contributing to GBD make clear that medication overuse is a global problem, not restricted to high-income countries.

Our analysis revealed no substantial differences in headache-attributed YLDs between the various GBD super-regions or across time. Notably, despite drawing data from 41 653 individuals, our meta-analysis of time in symptomatic state was unequipped for a detailed breakdown by location or year. Our results therefore

imply that there has been no meaningful change in the age-standardised prevalence of migraine or tension-type headache over the past three decades, suggesting no modulation of the underlying, and largely unknown, causes of these disorders. An important caveat to this observation is that the last literature review informing our prevalence estimates was done in 2017. Any potential effect of SARS-CoV-2 and the resultant pandemic is, therefore, not captured. Additionally, any recent shifts in headache-attributed burden following the introduction of new migraine-specific medications[22] such as CGRP inhibitors (to which time in symptomatic state would be more sensitive than prevalence) are not captured. Any such shifts would have been very small, because, even where these new medications are available (and in many parts of the world they are not),[23] coverage is minimal.

These updated findings of GBD strongly support the call for better headache care in all parts of the world.[24,25] Structured headache services, based in primary care, and tailored to local health-care infrastructure and resources, are the solution proposed by the Global Campaign against Headache.[26–28] The humanitarian argument for alleviating suffering is backed by theoretical modelling of the expected cost-effectiveness of structured headache services in all economies, with the potential for cost saving in some economies (taking the indirect costs of lost productivity into account).[28] Structured headache services are built on educational pillars, guiding people to appropriate levels of care (only a small minority need specialist care) while also promoting the appropriate use of efficacious treatments and discouraging overuse. In this context, it should be noted that efficacious treatments exist, but have low availability in many parts of the world.[23] Pharmaceutical companies, especially those marketing the new drugs, have both a responsibility and an opportunity here: rather than fighting to increase share in the saturated market of high-income countries, they should work together to expand the market, taking drugs affordably to low-income and middle-income countries.

To date, this is the most comprehensive analysis of population-level burden attributed to headache disorders. While this is a major strength, the study has several limitations, some already discussed. Prevalence data were scarce (or non-existent) in numerous countries, especially low-income countries and particularly with regard to tension-type headache and medication-overuse headache. Because of this, we caution against overly granular geographical comparisons, and in this Article compare only broader regional areas. Correction of prevalence estimates from studies possibly subject to systematic biases were also influenced by scarcity of data, which might have affected the reliability of the corrections. Correction was nevertheless perceived as preferable, as exclusion would have further decreased the number of data sources. GBD has models for only three headache types; although these three (among the 200 described in the ICHD)[6] are by far the greatest contributors to population health loss of headache disorders, and although any burden associated with secondary headaches is accounted for through the modelling of their underlying causes, there is unmeasured burden attributable to a few primary headaches other than migraine and tension-type headache (in particular, cluster headache). However, these primary headaches are relatively uncommon (cluster headache has a prevalence of about 0·1%),[5] so at population level they account for only a small number of YLDs, while the scarcity of robust epidemiological data prevents the construction of reliable models. The burden attributed to medication-overuse headache was wholly reattributed to migraine or tension-type headache. In a very small proportion of cases, another primary headache, such as chronic cluster headache or new daily persistent headache, might have been the preexisting headache type,[6] but these other headaches are relatively rare, and medication-overuse headache arising from them even rarer. Another limitation pertaining to our estimates for medication-overuse headache is the fact that they were derived from cross-sectional prevalence studies. Diagnoses therefore depended on the association of medication with high headache frequency, without evidence of causation. This is an insurmountable limitation of population-based studies. The new estimates of time in symptomatic state were derived from samples of people aged 18–65 years, and their validity for children, adolescents, and those aged over 65 years is unproven. Finally, no GBD risk factors (eg, high blood pressure, air pollution, malnutrition, or high LDL) informed our estimates.

In conclusion, headache disorders remain a very substantial global health concern as the sixth leading cause of health loss, affecting 2·9 billion individuals in 2023. The burden of headache disorders is twice as high among females, who not only have a higher prevalence of migraine but also, at an individual level, spend a greater proportion of their time with headache than males. While simple and cost-effective treatment options exist, they fail to reach many who would benefit from them, partly because headache care is poorly organised but also, and importantly, because of educational failures leading to suboptimal utilisation. The latter includes medication misuse, with regard to which the disproportionate effect of medication-overuse headache offers a compelling opportunity for health-loss prevention through education of both the population and health-care professionals.

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See appendix 2 (pp 12–16) for more detailed information about individual author contributions to the research, divided into the following categories: managing the overall research enterprise; writing the first draft of the manuscript; primary responsibility for applying analytical methods to produce estimates; primary responsibility for seeking, cataloguing, extracting, or cleaning data; designing or coding figures and tables; providing data or critical feedback on data sources; developing methods or computational machinery; providing critical feedback on methods or results; drafting the manuscript or revising it critically for important intellectual content; and managing the estimation or publications process. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit the manuscript for publication. Members of the core research team for this topic area (A K Husøy, Y Y Xu, J D Steinmetz, K L Ong, and T Vos) had full access to the underlying data used to generate estimates presented in this Article. All other authors had access to and reviewed estimates as part of the research evaluation process, which includes additional stages of formal review.

Data sharing

This study follows the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER). To download citations and metadata for the input data sources used in the GBD 2023 analyses presented in this study, please visit the GBD 2023 Sources Tool (https://ghdx.healthdata.org/gbd-2023/sources).

Declaration of interests

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