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Review Article

THE REPRESENTATION OF HEADACHE AND PAIN THROUGH THE LENS OF CULTURAL NEUROSCIENCE

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ABSTRACT

Introduction: Headache is a universally experienced neurological condition; however, its representation and subjective interpretation vary considerably across cultural contexts. Cultural neuroscience provides an integrative framework for understanding how sociocultural influences shape headache and pain experiences through identifiable neural mechanisms

Material and Methods: This narrative review synthesizes empirical and epidemiological evidence regarding cross-cultural variations in headache presentation, psychophysical pain profiles, and systemic clinical management barriers across diverse global populations.

Cross-cultural differences in headache expression are heavily driven by lived experiences of socioenvironmental stress and structural inequities. Chronic exposure to systemic discrimination, lower socioeconomic status, and acculturation stress function as physical stressors that accelerate central sensitization and the chronification of episodic headaches. Furthermore, culturally distinct illness models and expectations of clinical stoicism significantly influence symptom communication, contributing to diagnostic misclassification. Finally, structural healthcare barriers perpetuate profound inequities in patient access to novel, targeted migraine therapies .

Conclusion: Nociceptive processing appears to be relatively consistent across populations, whereas cultural factors influence the affective and contextual modulation of headache through identifiable neural circuits. Clinical implications highlight the importance of culturally informed assessment strategies and personalized therapeutic interventions.

Keywords: cultural neuroscience, headache, pain perception, neuroimaging, ethnic differences

INTRODUCTION

Headache disorders are among the most prevalent neurological complaints worldwide and represent a major contributor to global disability. Epidemiological data from the Global Burden of Disease Study consistently rank migraine and tension-type headache among the leading causes of years lived with disability across age groups and regions.[1] Although headache is a universal human experience, substantial cross-cultural variability exists in how individuals perceive, interpret, and communicate their symptoms. These differences extend beyond linguistic expression or

reporting style and may reflect culturally shaped patterns of cognitive appraisal, affective regulation, and neural processing of pain.[2,3] Cultural neuroscience has developed as an interdisciplinary field integrating cognitive neuroscience, cultural psychology, and anthropology to investigate how sociocultural environments shape brain function and behavior.[4] This framework conceptualizes pain as an embodied and contextually embedded experience, constructed through dynamic interactions between nociceptive signaling and sociocultural meaning systems. This perspective is particularly relevant in headache disorders, where symptom perception, disability reporting, and treatment outcomes vary across cultural groups.[5]

Sociocultural neuroscience proposes that cultural contexts influence multiple intermediate processes, including attentional orientation, cognitive interpretation, social meaning attribution, and emotion regulation. These processes modulate neural circuits implicated in pain processing. These influences are thought to operate through top-down regulatory pathways involving prefrontal, cingulate, and limbic regions that interact with primary nociceptive networks.[6]

From an enactive and embodied perspective, pain is not merely a passive sensory signal but a first-person experience arising from continuous interactions between the organism and its sociocultural environment. These culturally specific frameworks influence help-seeking behavior, symptom reporting, and possibly the cognitive-emotional modulation of headache-related neural activity.

MATERIAL AND METHODS

Literature searches for this review were conducted via PubMed and ScienceDirect explained in **Figure 1.** The keywords utilized were: “cultural neuroscience” OR “cross-cultural” - AND “headache” OR “pain perception” OR “pain representation” OR “cephalgia” - AND “brain” OR “neural”

Twenty articles featured in this review were chosen for their pertinence to the subject matter. The results were subsequently evaluated based on the title and abstract, as

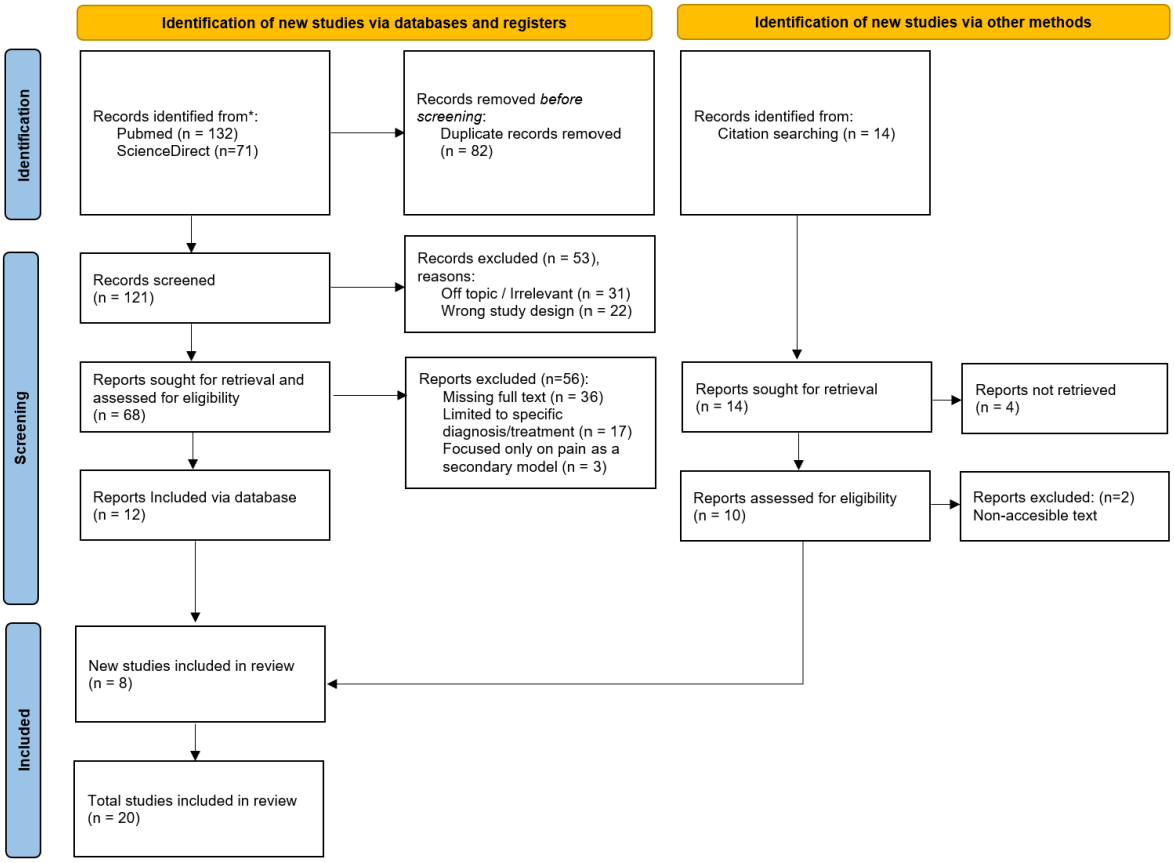

Figure 1. PRISMA 2020 Flow diagram

well as their inclusion criteripeer-reviewed study about headache and chronic pain within their cultural neuroscience fields, empirical study correlating pain/headache expression to their cultural base, study assessing and evaluating headache diagnosis and treatment within their respective culture, article reviews and meta-analysis of theoretic pain and headache, with the publication and/or abstract within English and Bahasa Indonesia. Exclusion criteria include duplicate results / follow-up, focused only on headache as a general population study, study done only on

animal subjects, non-accessible text, non-peer-reviewed (non-data articles). Twenty studies were included to be reviewed throughout their respective key findings toward cultural/ethnic differences upon headache or other pain-related diagnosis. Table 1 explains each study with its study population, design, key findings, and clinical relevance.

DISCUSSION

Thematic Domains

Twenty studies included in Table 1 can be grouped into three specific thematic domains to demonstrate how sociocultural mechanisms directly translate into clinical headache phenotypes and healthcare disparities, as seen in Table 2. The domains are separated into 3 main focuses: psychosocial stressors & allostatic load; cultural illness models & linguistic metaphors; and healthcare access & neuro-therapeutic disparities.

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Thematic Domain 1: Psychosocial Stressors and Allostatic Load

This component synthesizes studies examining how chronic environmental stress, structural discrimination, and lower socioeconomic status (SES) function as upstream physical modifiers of headache biology. Chronic exposure to racial discrimination and systemic socioeconomic precarity activates the hypothalamic-pituitary-adrenal (HPA) axis, inducing a state of sustained allostatic load. This persistent neuroendocrine activation triggers an upstream release of pro-inflammatory cytokines (such as IL-6 and TNF-alpha). These circulating signaling molecules directly lower the threshold for nociceptive firing within the meningeal vessels, accelerating central sensitization in the trigeminocervical complex (TCC). Starling et al. (2025) documents a direct correlation between high scores on perceived discrimination indices and an increased frequency and severity of migraine attacks within minoritized communities. Domenico et al. (2024) & Umeda et al. (2025): Though grounded broadly in chronic pain, these cohorts demonstrate that socioenvironmental stress alters frontostriatal connectivity and sensory gating networks—mechanisms that regulate how the ventroposteromedial (VPM) thalamus handles trigeminal influx during a primary headache attack.[8,12,28]

Thematic Domain 2: Cultural Illness Models and Communication Metaphors

This domain shifts from purely biological stressors to cognitive and linguistic variables,

Table 1. Summary of literature comparing pain within the many scopes of culture and circumstances

No.	Author(s) and Year	Study Population/ Ethnicity	Study Design/ Methods	Key Findings Related to Cultural/Ethnic Differences	Clinical Relevance
1	Domenico et al., 2024.[8]	147 non-Hispanic Black and non-Hispanic White adults with chronic knee pain	Cross-sectional MRI study with hierarchical regression models	Environmental and sociocultural factors (income, education, discrimination, social support) explained 6-37% of variance in pain-related brain regions. Ethnicity-race provided additional 4-13% explanatory value in amygdala, hippocampus, insula, somatosensory cortex, and thalamus after controlling for socioenvironmental factors.	Clinicians should consider environmental and sociocultural factors when assessing pain-related neural differences. Interventions targeting social determinants may reduce pain disparities.
2	Mei et al., 2025.[9]	Adults undergoing racial identification training	fMRI/EEG experimental study with mask training procedure	Mask training using other-race facial disguises altered racial identification and reduced racial ingroup biases in empathy for pain. Neural responses to others' pain showed stronger activation for own-race versus other-race individuals, modulated by racial identification.	Provider empathy and pain assessment may be influenced by racial concordance. Bias reduction training targeting racial identification may improve cross-cultural clinical encounters.
3	Starling et al., 2025.[10]	Diverse racial/ethnic groups with migraine (survey study)	Cross-sectional survey (Migraine Report Card)	Black/African American and Hispanic/Latino individuals reported greater migraine-related functional disability and lower treatment satisfaction compared to non-Hispanic White individuals despite similar headache frequencies. Disparities in access to preventive treatments and specialist care.	Healthcare systems must address treatment access disparities and ensure equitable distribution of migraine-specific therapies across racial/ethnic groups.
4	Granger et al., 2025.[11]	African American and Caucasian populations with chronic pain	Narrative review of pain neuroscience education interventions	Pain neuroscience education shows promise for reducing opioid dependency, but cultural adaptation is	Pain education interventions should be culturally tailored using relevant examples,

				essential for optimal outcomes in African American populations. Generic educational materials may not resonate with diverse patients' lived experiences.	addressing community-specific concerns, and incorporating cultural strengths.
5	Umeda et al., 2025.[12]	Asian Americans and non-Hispanic Whites	Experimental psychophysical study	Physical activity levels and racial discrimination experiences jointly influenced pain sensitivity, with differential effects between Asian American and non-Hispanic White participants. Complex interactions between social experiences and pain perception.	Pain sensitivity assessment should incorporate social experiences such as discrimination. Physical activity interventions may have differential effects across ethnic groups.
6	Kellier et al., 2025.[13]	Pediatric patients with headache in emergency departments	Retrospective analysis of emergency department encounters	Black/African American and Hispanic/Latino children were less likely to receive migraine diagnoses and more likely to undergo diagnostic testing compared to non-Hispanic White children with similar presentations.	Provider bias training and standardized diagnostic protocols may reduce racial disparities in pediatric headache diagnosis and unnecessary testing.
7	Mendes et al., 2026.[14]	Brazilian and Spanish individuals with temporomandibular disorders	Comparative qualitative study	Distinct cultural patterns in diagnosis perceptions, information-seeking behaviors, and treatment expectations between Brazilian and Spanish populations. Cultural frameworks shape illness conceptualization and healthcare interactions.	Clinicians should elicit patients' explanatory models of pain and headache, respecting cultural beliefs and collaboratively developing culturally concordant treatment plans.
8	Lipton et al., 2023[15]	English-speaking and Spanish-speaking migraine populations, with a primary focus on Hispanic/Latino demographic sub-cohorts	Comparative clinical evaluation	Different linguistic cohorts employ varied terminology and semantic weights to describe primary headache symptoms (such as substituting emotional/somatic framework metaphors for rigid structural choices), which can alter the baseline	Direct and literal translations of standard Western diagnostic criteria often overlook linguistic nuances and distinct cultural idioms of distress.

				performance of standard screening questionnaires across different ethnic backgrounds.	
9	Hsu et al., 2024.[16]	Asian patients with idiopathic intracranial hypertension	Retrospective dual-center study	Asian populations demonstrated unique clinical characteristics and outcomes of idiopathic intracranial hypertension compared to Western populations, potentially reflecting genetic, body habitus, and cultural factors.	Healthcare providers should be aware of population-specific headache phenotypes to ensure accurate diagnosis and appropriate management in Asian patients.
10	Kissi et al., 2025.[17]	Observers assessing pediatric pain in Black and White children	Experimental study of pain assessment bias	Observers underestimated pain in Black children compared to White children with identical pain behaviors. Bias correlated with differential attentional processing of pain cues based on child's race.	Racialized bias in pain assessment leads to inadequate treatment. Structured pain assessment tools and bias reduction training are essential for equitable pediatric pain care.
11	Simis et al., 2024.[18]	Individuals with limb amputations	Functional near-infrared spectroscopy (fNIRS) study	Distinct patterns of metabolic motor cortex activity for phantom versus residual limb pain. While not focused on race/ethnicity, demonstrates advanced neuroimaging techniques applicable to studying pain across diverse populations.	Advanced neuroimaging techniques can elucidate pain mechanisms and may be applied to examine neural differences across racial/ethnic groups in future research.
12	Almughyiri, 2026.[19]	Individuals with developmental disabilities in Saudi Arabia	Qualitative interview study	Cultural factors in Saudi Arabia influence pain expression, family involvement in care, and treatment preferences. Cultural norms regarding disability and pain shape healthcare interactions.	Culturally informed approaches must respect family structures, religious beliefs, and cultural norms when providing pain care in Middle Eastern populations.
13	Meksa et al., 2025.[20]	Adults in Latvia	Population-based survey methodology	Describes methodology for characterizing headache epidemiology in understudied regions. Emphasizes importance of standardized	Standardized epidemiological methods enable cross-cultural comparisons and identification

				assessment across diverse global contexts.	of region-specific headache burden and risk factors.
14	Vgontzas et al., 2025. [21]	Hispanic/Latino populations (HCHS/SOL study)	Cross-sectional epidemiological study	High rates of comorbid migraine and sleep disturbances in Hispanic/Latino populations. Comorbidity patterns may reflect cultural factors (shift work, household structures), genetic susceptibility, and socioeconomic stressors.	Clinicians should screen for sleep disorders in Hispanic/Latino patients with migraine and address cultural factors affecting sleep (work schedules, household dynamics).
15	Getz et al., 2025.[22]	Black/African American individuals with migraine	Cross-sectional survey study	Perceived discrimination significantly predicted worse migraine-specific quality of life and disability, independent of headache frequency and intensity. Discrimination exerts direct effects on headache burden.	Addressing discrimination experiences and providing trauma-informed care may improve migraine outcomes in Black/African American patients.
16	Seeluangsawat et al., 2025.[23]	Thai patients in university hospital headache clinic	Validation study of screening questionnaire	Successful validation of medication overuse headache self-screening questionnaire in Thai population. Demonstrates importance of cultural adaptation and validation of assessment tools.	Assessment tools must be culturally validated across diverse populations. Linguistic translation alone is insufficient; cultural adaptation is essential.
17	Roman-Juan et al., 2025.[24]	Immigrant adolescents across 30 European countries	Cross-national epidemiological study	Higher chronic pain prevalence and greater functional impairment among immigrant youth compared to native-born peers. Reflects pre-migration trauma, acculturation stress, discrimination, and healthcare access barriers.	Healthcare providers should assess immigration history, acculturation stress, and trauma in adolescent pain patients. Culturally appropriate interventions are needed for immigrant populations.
18	Buse et al., 2026.[25]	Patients with migraine medication payer denials	Observational cohort study using multi-source datasets	High rates of payer denials for branded acute and preventive migraine medications. Prior authorization requirements disproportionately burden patients	Policy reforms streamlining or eliminating prior authorization for evidence-based migraine treatments may reduce disparities in treatment access.

				with public insurance or lower socioeconomic status.	
19	González-de-la-Flor et al., 2026.[26]	Spanish-speaking individuals with chronic musculoskeletal pain	Psychometric validation study	Validation of Spanish-language adherence to exercise tool (ATEMPT) demonstrates importance of linguistically and culturally appropriate assessment instruments for treatment adherence.	Validated, culturally appropriate tools for assessing treatment adherence enable better monitoring and support for non-English-speaking patients with chronic pain.
20	Nandyala et al., 2025.[27]	Patients at tertiary headache center	Retrospective cohort analysis	Significant socioeconomic disparities in migraine medication prescriptions. Lower SES associated with reduced access to newer, more effective preventive treatments. Insurance status strongly predicted treatment access.	Healthcare systems must address insurance coverage barriers and ensure equitable access to evidence-based migraine treatments regardless of socioeconomic status.

Table 2. Thematic domain extracted from twenty studies included in the study

Thematic Category / Domain	Focus Mechanisms & Variables
1. Psychosocial Stressors & Allostatic Load	- Structural and systemic discrimination - Socioeconomic status (SES) & deprivation indices - HPA-axis dysregulation & cytokine release - Trigeminovascular sensitization & PAG gating failure
2. Cultural Illness Models & Linguistic Metaphors	- Idioms of distress & somatic appraisals - Culturally dictated stoicism vs. expression - ICHD-3 diagnostic misclassification risks - Cross-cultural variations in headache reporting
3. Healthcare Access & Neuro-Therapeutic Disparities	- Anti-CGRP prescription and referral gaps - Risk profiles for medication-overuse headache (MOH) - Acculturation and language barriers in migrants - Digital divide and telemedicine limitations in PNE

categorizing how different global populations construct, categorize, and report their headache symptoms. Diagnostic criteria in modern neurology (such as the International Classification of Headache Disorders, 3rd edition or ICHD-3) rely heavily on Eurocentric symptom descriptions (e.g., "throbbing," "pulsating," "unilateral"). Table 1 highlights that many collectivistic or immigrant populations utilize highly distinct somatic metaphors or holistic frameworks to communicate primary headaches. Cohort Data (Lipton et al., 2023) demonstrates that Hispanic/Latino populations frequently describe headache pathology through somatic or emotional distress frameworks (e.g., linking attacks to *sustos* or environmental imbalances). More ethnographic sub-analyses highlights how cultural expectations of stoicism vs. vocal expression alter clinical presentation. In cultures prioritizing high stoicism, patients minimize or delay reporting high disability scores. This frequently misleads clinicians into diagnosing a severe migraine variant as a benign tension-type headache, resulting in therapeutic under-management.[1515,29]

Thematic Domain 3: Structural Disparities in Healthcare Access and Neuro-Therapeutics

The final structural domain of Table 1 tracks the tangible, real-world treatment inequities that manifest down-stream from cultural and financial stratifications. The unequity gap section audits the unequal distribution of modern, targeted primary headache therapies. While the development of calcitonin gene-related peptide (CGRP) monoclonal antibodies and small-molecule gepants has revolutionized headache medicine, Table 1 tracks how social determinants of health restrict their clinical deployment. Healthcare Utilization Studies highlights that minoritized, immigrant, and low-SES patients presenting with classic migraine symptoms are statistically less likely to be prescribed premium targeted therapies (anti-CGRP pathways) or referred to specialized tertiary headache centers. Instead, they are disproportionately managed with older, generic prophylactics with poor tolerability, or defaulted to acute rescue medications like NSAIDs or opioids. Immigrant & Refugee Inequities (Fazel et al., 2005; Close et al., 2016): Document that language barriers, fear of institutional tracking, and lack of culturally adapted Pain Neuroscience Education (PNE) act as massive obstacles, preventing vulnerable populations from navigating the health system to secure precision neurological care.[27,30,31]

Neural and Brain Differences Across Race/Ethnicity

Neuroimaging studies indicate that observed racial and ethnic differences in pain-related brain structure are largely shaped by environmental and sociocultural determinants rather than biological race alone. Magnetic resonance imaging research in adults with chronic musculoskeletal pain comparing non-Hispanic Black and non-Hispanic White participants has demonstrated associations between socioenvironmental variables and morphology of pain-related brain regions. Hierarchical regression analyses show that socioeconomic indicators—including income, education, discrimination exposure,

and social support, accounting for a substantial proportion of variance (approximately 6–37%) in structural measures of pain-related brain regions. After adjustment for these contextual variables, self-identified race/ethnicity contributes additional explanatory variance in limbic and sensory regions such as the amygdala, hippocampus, insula, primary somatosensory cortex, and thalamus. In contrast, structural differences in prefrontal and anterior cingulate regions appear to be largely explained by environmental and psychosocial factors, with race/ethnicity no longer remaining a significant independent predictor once these variables are considered.[32,33]

These findings underscore the multifactorial etiology of neural variation observed across racial and ethnic groups in pain populations. Limbic structures including the amygdala and hippocampus, which are central to emotional regulation and memory processes, are particularly sensitive to chronic stress exposure and discrimination experiences that disproportionately affect marginalized populations. [34]

Neural processes underlying empathy for pain are also shaped by cultural and racial context. Using combined fMRI and EEG approaches, Mei and colleagues demonstrated that racial group membership modulates neural responses to observing others in pain, with stronger empathic activation when individuals view pain experienced by members of their own racial group compared with other groups.[935,36] Although this work focuses on vicarious pain rather than first-person nociceptive experience, it provides evidence that social identity influences neural processing of pain-related information. These findings carry important clinical implications, as clinician empathy, pain interpretation, and treatment decision-making may be implicitly shaped by racial concordance or discordance between patient and provider. [36,37]

Umeda et al examined pain sensitivity among Asian American and non-Hispanic White adults and assessed the moderating effects of physical activity and experiences of racial discrimination. Their results

demonstrated interactive effects in which physical activity and discrimination exposure jointly influenced experimental pain sensitivity, with patterns differing between ethnic groups.[12] These findings highlight that pain sensitivity, a core psychophysical construct, is shaped not only by physiological mechanisms but also by lived social experiences such as discrimination and chronic stress.[34] Research assessing pain perception during medical procedures in multi-ethnic clinical cohorts similarly reports ethnic variation in pain reporting, tolerance, and treatment response. Such differences are understood to reflect combined neurobiological influences, including genetic variability in nociceptive pathways and endogenous opioid function, as well as sociocultural determinants such as norms governing pain expression, expectations surrounding medical care, and trust in healthcare systems.[2,38]

Social and Cultural Perspectives on Pain and Headache

Cultural frameworks play a central role in shaping how individuals perceive, interpret, and communicate experiences of pain and headache symptoms. Qualitative and cross-cultural research consistently demonstrates substantial variation in how pain is conceptualized and described across populations. These culturally shaped explanatory models are also observed in headache disorders, where beliefs about causation including stress, lifestyle factors, and spiritual or supernatural explanations which affect help-seeking behavior, treatment preferences, and adherence.[39]

Norms governing the expression of pain differ markedly across cultural and ethnic groups, influencing whether individuals minimize or openly communicate symptoms. Cultural contexts that emphasize stoicism may lead individuals to underreport headache severity, which can contribute to delayed diagnosis and undertreatment.[38] Conversely, cultural norms that support expressive communication of distress may result in pain behaviors that clinicians unfamiliar with these communication styles could

misinterpret, potentially contributing to symptom dismissal or bias in clinical evaluation.[37]

Discrimination, Social Stress, and Headache Burden

Experiences of racial and perceived discrimination represent major psychosocial stressors that influence headache outcomes and overall pain burden.[40] Empirical work in migraine populations demonstrates that perceived discrimination is associated with poorer headache-related quality of life and increased disability. In a study of Black/African American individuals with migraine, discrimination experiences significantly predicted worse migraine-related disability and reduced quality of life. Importantly, these associations remained significant after adjusting for headache frequency and pain intensity, indicating that discrimination contributes independently to headache burden.[22] Several biological and behavioral pathways may explain the link between discrimination and headache burden. Chronic discrimination-related stress activates hypothalamic–pituitary–adrenal (HPA) axis and sympathetic nervous system responses, which can promote inflammatory signaling and increase vulnerability to central sensitization processes relevant to headache disorders.[41]

Socioeconomic Factors and Healthcare Access

Socioeconomic status (SES) is a key social determinant of health that intersects with race and ethnicity to shape headache prevalence, treatment access, and clinical outcomes. Research conducted in tertiary headache settings demonstrates that socioeconomic indicators—including insurance coverage, are associated with disparities in access to migraine treatments, particularly newer preventive therapies. Analyses of migraine medication prescribing patterns reveal that patients with lower SES are less likely to receive advanced pharmacologic treatments and specialty care.[27] Lower socioeconomic position is also linked to reduced access to

non-pharmacological interventions such as cognitive behavioral therapy, behavioral headache management, and biofeedback approaches.[41] The intersection of race, ethnicity, and SES produces cumulative disadvantage that contributes to disparities in headache burden and care.[40]

Immigrant and Refugee Populations

Immigrant and refugee populations encounter distinct challenges in the experience and management of pain and headache due to complex social and environmental stressors. Roman-Juan et al. examined chronic pain disparities among immigrant adolescents across 30 European countries and found that immigrant youth reported higher pain prevalence and greater functional limitations compared with native-born peers.[24] These disparities are likely driven by multiple interacting determinants, including pre-migration trauma, acculturation stress, perceived discrimination, language barriers, and limited availability of culturally responsive care.[30,42] With respect to headache disorders, immigrant populations may demonstrate increased migraine frequency associated with psychosocial stress, dietary transitions, disrupted sleep patterns, and reduced access to preventive healthcare services.[43] Such differences can generate challenges during clinical encounters when patient expectations, symptom descriptions, and treatment beliefs are not aligned with clinician perspectives.[44]

Diagnostic Disparities and Bias in Pain Treatment

Significant racial and ethnic disparities persist in the diagnosis of headache disorders, particularly within acute and emergency care environments.[37] Analyses of pediatric emergency department visits for headache indicate that Black/African American and Hispanic/Latino children are less likely to receive a migraine diagnosis compared with non-Hispanic White children presenting with comparable symptoms. Evidence further shows that children from minority groups undergo higher rates of diagnostic

testing, including neuroimaging, despite lower migraine diagnosis rates, suggesting concurrent underdiagnosis of primary headache disorders and possible overuse of low-value investigations.[13] Cultural variation in pain expression can also influence clinician interpretation, increasing the risk of misjudging symptom severity or functional impact.[45] Measures originally developed in predominantly White, English-speaking samples may fail to capture culturally specific symptom descriptions or may contain items interpreted differently across populations.[46]

Within headache care, racial bias may influence prescribing patterns and therapeutic decision-making.[47] Evidence suggests that patients from racial and ethnic minority groups are less likely to receive migraine-specific acute therapies, including triptans, and more likely to receive non-specific analgesics or be perceived as seeking medications inappropriately.[48] Disparities are also observed in access to preventive migraine treatments, including newer calcitonin gene-related peptide (CGRP) monoclonal antibodies, with prescribing patterns differing across racial and socioeconomic groups.[27] These inequities reflect the combined effects of clinician-level bias and structural barriers such as insurance restrictions, prior authorization requirements, and unequal access to specialty care that disproportionately affect minority populations.[49]

Effective headache management requires treatment strategies that are culturally adapted to improve patient engagement, adherence, and clinical outcomes.[44] Studies focusing on African American populations indicate that standardized educational materials may not fully reflect patients' lived experiences or sociocultural contexts, highlighting the need for culturally responsive adaptation.[11] Cultural adaptation includes integrating culturally meaningful examples, addressing community-specific concerns such as historical medical mistrust, and leveraging cultural strengths including spirituality, family networks, and community support within treatment planning.

Medication adherence in headache treatment is strongly influenced by cultural beliefs and perceptions

regarding pharmaceuticals.[50] In some cultural contexts, patients may prioritize natural or traditional remedies and express skepticism toward prescription medications, while others may hold specific concerns regarding dependence, safety, or adverse effects that differ from clinician assumptions.[51] Exploring and addressing these beliefs through shared decision-making is essential for improving treatment adherence and therapeutic alliance in headache care.[52] Furthermore, integrating culturally valued complementary approaches such as acupuncture, herbal medicine, and spiritual practices, alongside biomedical therapy may enhance treatment engagement and overall outcomes in headache management.[53]

Future Directions

Future investigations into headache disorders should incorporate sociocultural influences within neurobiological frameworks to better capture the complexity of pain mechanisms. Traditional biomedical approaches primarily highlight genetic vulnerability, neurotransmitter abnormalities, and cortical spreading depression as central mechanisms underlying migraine pathophysiology. Although these biological mechanisms are essential, their manifestation and clinical consequences are shaped by broader sociocultural environments that influence health behaviors, stress exposure, and access to care. Evidence from neuroimaging research demonstrates that environmental and sociocultural conditions contribute significantly to variability in brain structures involved in pain processing, supporting the need for biopsychosocial models that integrate social determinants of health.

There is a critical need to develop headache assessment instruments that are culturally validated to ensure accurate measurement across diverse populations. Widely used tools such as the Migraine Disability Assessment (MIDAS), Headache Impact Test-6 (HIT-6), and other pain rating scales were originally created within Western, English-speaking contexts, which may limit their cross-cultural

applicability.[54] Future research should implement rigorous cross-cultural adaptation procedures, including cognitive interviewing with patients from target populations, multidisciplinary expert review panels representing the community, and psychometric testing in representative samples to establish validity and reliability.

Education for healthcare professionals should place strong emphasis on identifying and mitigating implicit bias in clinical practice, particularly in pain evaluation and treatment. Future headache research should incorporate community-based participatory research (CBPR) methodologies that actively involve racial and ethnic minority communities as equitable collaborators throughout the research process. Reducing disparities in headache care requires coordinated policy initiatives and healthcare system reforms that target structural determinants of inequity. A primary priority is expanding insurance coverage to ensure equitable access to comprehensive headache services, including specialist evaluation, preventive pharmacotherapy, and non-pharmacological treatments. Reforming prior authorization processes represents another critical strategy, as administrative barriers frequently delay or limit access to evidence-based headache therapies and disproportionately affect socioeconomically disadvantaged and minority populations. Simplifying or eliminating unnecessary prior authorization requirements may accelerate treatment initiation and reduce inequitable care delays.

CONCLUSION

This narrative review highlights that headache should be understood through a cultural neuroscience perspective, where neurobiological mechanisms interact dynamically with sociocultural contexts. Evidence from neuroimaging and behavioral research indicates that factors such as discrimination, socioeconomic conditions, and social support significantly influence pain-related brain structures and contribute to observed differences in headache experiences across racial and ethnic

groups. These findings challenge purely biological explanations for disparities and support biopsychosocial models that incorporate social determinants of health.

Cultural beliefs, norms of pain expression, and experiences within healthcare systems shape how individuals perceive, communicate, and seek treatment for headache, often intersecting with systemic barriers that produce inequities in diagnosis, treatment, and outcomes. Addressing these disparities requires culturally informed clinical practice, including bias-aware assessment, culturally adapted interventions, and structural reforms that improve healthcare access. Future research should integrate sociocultural variables into neurobiological models, develop culturally validated tools, and implement community-engaged and policy-level interventions, recognizing that equitable headache care depends on approaches that acknowledge the complex interplay of biological, social, and cultural influences.

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