

Role of magnetic resonance imaging in evaluation of patients with chronic primary headaches

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ABSTRACT

INTRODUCTION

Headaches are often associated with neurological disorders and contribute to the growing global health challenges. They can be classified as primary or secondary. Magnetic resonance imaging (MRI) has become increasingly crucial for understanding the underlying mechanisms of chronic primary headaches. This study aimed to evaluate the significance of MRI in the assessment of patients with chronic primary headache.

MATERIAL AND METHODS

This cross-sectional study was conducted on 140 patients who underwent brain MRI from March to September 2025 at the Department of Radiodiagnosis and Medical Imaging, Universal College of Medical Sciences and Teaching Hospital, Nepal. Siemens Magnetom Lumina 3T MRI was utilized for all scans. Data analysis was performed using SPSS version 20.

RESULTS

Of the 140 patients, 57.14% were females and 42.86% were males. The mean age was 45.19 years (SD±14.86), and ages ranged from 12 to 77 years. The largest proportion of patients was in the 31-40 age group, representing about 24.28% of the total participants. Migraine was the most common type of headache observed, comprising 65% of cases.

CONCLUSION

This study evaluated MRI findings in patients with chronic primary headaches who were referred for imaging. The majority of participants were females, and the MRI results appeared mostly normal.

KEYWORDS

Magnetic Resonance Imaging, Chronic primary headache, Sinusitis

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INTRODUCTION

Headaches are frequently reported issues in medical practice and are the most prevalent neurological symptoms.¹ The World Health Organization identifies headaches as one of the ten most disabling health conditions worldwide.^{2,3} Headaches can be classified clinically as either primary or secondary, depending on whether they are related to a specific medical condition; primary headache disorders are more prevalent and are not related to any medical condition.⁴⁻⁶ Neuroimaging is useful to distinguish primary from secondary headaches and should be used in the presence of clinical red flags, such as changes in the symptoms of headache, neurological impairment, sudden onset, headache after 50 years of age and lack of response to treatment.^{7,8}

Chronic primary headache is defined as headache that has occurred for at least four weeks and encompasses migraines, tension-type headaches, and cluster headaches.⁹ MRI is a useful noninvasive diagnostic tool for headache disorders because of its high soft tissue contrast and multiplanar imaging capabilities; it is the neuroimaging modality of choice for patients with chronic headaches to rule out secondary causes such as tumors and vascular malformations.¹⁰ In addition, advanced MRI techniques, like Functional Magnetic Resonance Imaging (fMRI), Magnetic Resonance Angiography (MRA), and Diffusion Tensor Imaging (DTI), have also significantly expanded our knowledge of primary headaches by revealing subtle brain changes, including differences in cortical thickness and white matter integrity.¹¹⁻¹⁴ This study aimed to evaluate the significance of MRI in the assessment of patients with chronic primary headache.

MATERIAL AND METHODS

This prospective cross-sectional study was conducted in the Department of Radiodiagnosis and Medical Imaging at the Universal College of Medical Sciences and Teaching Hospital (UCMS-TH), Bhairahawa, Rupandehi, Nepal, from March to September 2025. Ethical approval was obtained from the Institutional Review Committee of UCMS-TH (Ref. No. UCMS/IRC/056/25), and written informed consent was obtained from all participants prior to enrollment. A total of 140 patients with chronic primary headaches were included in this study. The sample size was determined using the cohort formula $n = z^2pq/e^2$, where z represents the 95% confidence level, p the prevalence (23.08%)¹⁵ and e the allowable error (7%).

Patients were eligible for inclusion if they presented a primary complaint of chronic primary headache, had a history of headache for at least 3 months, were of any age and were willing to provide informed consent to the study. Patients were excluded if they had an acute head injury, a history of neurosurgery, secondary headache, severe comorbid medical conditions, and contraindications to MRI or refused to consent.

MRI scan was performed using a 3T Siemens Magnetom Lumina, with a slice thickness of 4-5 mm, an interslice gap of 1 mm, a field of view (FOV) of 220 mm, including transverse and sagittal T1-weighted sequences; transverse, sagittal, and coronal T2-weighted sequences; transverse fluid-attenuated inversion recovery (FLAIR) T2-weighted imaging; diffusion-weighted imaging (DWI) using resolve 3-scan trace in the transverse plane; susceptibility-weighted imaging (SWI) and post-contrast T1-weighted sequences after administration of gadolinium diethylene triamine pentacetate. The MRI findings were recorded using a structured proforma and analyzed with SPSS version-20. The data were summarized using numerical descriptors and statistical associations were tested between categorical variables using Pearson's Chi-squared test.

RESULTS

One hundred forty patients with chronic primary headache as their chief complaint were included in the study (42.86% male and 57.14% female) with a mean age of 45.19 ± 14.86 years (range: 12-77 years). The leading age group was 31-40 years (24.28%), followed by 51-60 years (20.71%) and patient under 20 years and over 70 years (4.29% for each one). This study also investigated the associated symptoms and relevant history of patients with chronic primary headaches. The most common symptoms reported were nausea (72.86%), vomiting (65.71%), neck pain (48.57%), and photophobia (38.57%). Regarding lifestyle factors, 47.14% had a history of smoking and 37.14% consumed alcohol. Migraine was the most prevalent type, present in 65% of patients (Table 1).

Table 1. Baseline characteristics of study participants, n=140

Characteristics	Frequency	Percentage
Age (years)		
< 20	06	4.29
21-30	18	12.86
31-40	34	24.28
41-50	26	18.57
51-60	29	20.71
61-70	21	15.0
>70	06	4.29
Age (mean \pm SD)	45.19 \pm 14.86 years	
Gender		
Male	60	42.86
Female	80	57.14
MRI Request Site		
In-patient (IPD)	30	21.43
Out-patient (OPD)	110	78.57
Associated symptoms		
Nausea	102	72.86
Vomiting	92	65.71
Photophobia	54	38.57
Neck Pain	68	48.57
Smoking	66	47.14
Alcohol consumption	52	37.14
Types of headache		
Migraine	91	65.00
Tension-type	37	26.43
Cluster	12	8.57

Table 2. MRI abnormalities detected in chronic primary headache patients, n=140

MRI Findings	Frequency	Percentage
Paranasal sinusitis	32	22.86
Sinus Polyposis	04	2.86
Neurodegenerative disease	05	3.57
Orbital pathologies	03	2.14
Granuloma/ calcification	02	1.43
Normal	94	67.14

Table 2 shows the MRI findings for 140 patients with chronic primary headache, revealing that 67.14% had normal scans. Paranasal sinusitis was the most prevalent abnormality, accounting for 22.86% of all findings. Degenerative diseases accounted for 3.57% of the findings, while other findings were less frequent.

Table 3. Association between various parameters and MRI findings

Present	MRI Findings											
	Paranasal sinusitis		Sinus Polyposis		Neurodegenerative disease		Orbital pathologies		Granuloma/calcification		Normal	
	Present	Absent	Present	Absent	Present	Absent	Present	Absent	Present	Absent	Present	Absent
Male												
No. (%)	15 (25%)	45 (75%)	3 (5%)	57 (95%)	2 (3.3%)	58 (96.7%)	2 (3.3%)	58 (96.7%)	0	60 (100%)	40 (66.7%)	20 (33.3%)
Female												
No. (%)	17 (21.2%)	63 (78.8%)	1 (1.2%)	79 (98.8%)	3 (3.8%)	77 (96.2%)	1 (1.2%)	79 (98.8%)	2 (2.5%)	78 (97.5%)	56 (70%)	24 (30%)
<i>P</i> -value	.601		.188		.895		.400		.217		.674	
Nausea	24 (23.5%)	8 (21.1%)	4 (3.9%)	0 (4.9%)	5 (2.9%)	0 (2.0%)	3 (64.7%)	0 (78.9%)	2	0	66	30
<i>P</i> -value	.756		.216		.165		.285		.385		.106	
Vomiting	19 (20.7%)	13 (27.1%)	4 (4.3%)	0 (2.2%)	2 (6.2%)	3 (3.3%)	3 (1.1%)	0 (2.1%)	1 (70.7%)	1 (64.6%)	65	31
<i>P</i> -value	.390		.143		.217		.206		.637		.463	
Photophobia	13 (24.5%)	19 (21.8%)	1 (1.9%)	3 (3.4%)	2 (3.8%)	3 (3.4%)	1 (1.9%)	2 (2.3%)	0 (2.3%)	2 (71.7%)	38 (66.7%)	58
<i>P</i> -value	.713		.591		.920		.870		.266		.534	
Neck Pain	15 (22.1%)	17 (23.6%)	1 (1.5%)	3 (4.2%)	4 (5.9%)	1 (1.4%)	0 (4.2%)	3 (1.5%)	1 (1.4%)	1 (70.6%)	48 (66.7%)	48
<i>P</i> -value	.827		.339		.152		.089		.968		.617	
Smoking	16 (24.6%)	16 (21.3%)	4 (6.2)	0 (3.1%)	2 (4%)	3 (3.1%)	2 (1.3%)	1 (1.5%)	1 (1.3%)	1 (64.6%)	42 (72%)	54
<i>P</i> -value	.645		.029		.769		.477		.919		.348	
Alcohol consumption	14 (24.6%)	18 (21.7%)	3 (5.3%)	1 (1.2%)	2 (3.5%)	3 (3.6%)	2 (3.5%)	1 (1.2%)	0 (2.4%)	2 (66.7%)	38 (69.9%)	58
<i>P</i> -value	.691		.157		.974		.355		.238		.687	
Migraine	23 (25.3%)	9 (18.4%)	3 (3.3%)	1 (2%)	3 (3.3%)	2 (4.1%)	3 (3.3%)	0 (2.2%)	2 (64.8%)	0 (75.5%)	59	37
<i>P</i> -value	.353		.671		.811		.199		.296		.194	
Tension Type headache	8 (21.6%)	24 (23.3%)	1 (2.7%)	3 (2.9%)	1 (2.7%)	4 (3.9%)	0 (2.9%)	3 (1.9%)	0 (73%)	2 (67%)	27	69
<i>P</i> -value	.835		.948		.740		.294		.393		.501	
Cluster headache	1 (8.3%)	31 (24.2%)	0 (3.1%)	4 (16.7%)	2 (2.3%)	3 (2.3%)	0 (1.6%)	3 (75%)	0 (68%)	2	9	87
<i>P</i> -value	.210		.534		.011		.592		.663		.616	

The association between various clinical parameters and MRI findings is shown in table 3, where no significant associations were found. However, statistically significant associations were observed between smoking and sinus polyposis ($p = 0.029$), cluster headache and neurodegenerative disease ($p = 0.011$), and no other significant correlations were observed ($p > 0.05$).

Table 4. Association between age group and MRI findings

Parameters	<40		>40		P-value
	No. (%)		No. (%)		
	Present	Absent	Present	Absent	
Paranasal sinusitis	15 (25.9%)	43 (74.1%)	17 (20.7%)	65 (79.3%)	.476
Sinus Polyposis	3 (94.8%)	55 (5.2%)	1 (1.2%)	81 (98.8%)	.167
Neurodegenerative disease	0	58 (100%)	5 (6.1%)	77 (93.9%)	.055
Orbital pathologies	1 (1.7%)	57 (98.3%)	2 (2.4%)	80 (97.6%)	.774
Granuloma/ calcification	0	58 (100%)	2 (2.4%)	80 (97.6%)	.231
Normal	39 (67.2%)	19 (32.8%)	57 (69.5%)	25 (30.5%)	.776

Table 4 illustrates the association between age group and MRI findings in patients with chronic primary headaches. No associations reached statistical significance at the 0.05 level; the only association approaching significance was between age >40 years and neurodegenerative disease ($p = 0.055$), which did not reach the necessary threshold. There were no significant differences ($p > 0.05$) in other MRI findings between the two age groups.

DISCUSSION

Headaches are common neurological problems in both adults and pediatrics. Neuroimaging plays a crucial role in evaluating chronic primary headaches. However, differences in study results often arise from different definitions of clinically relevant outcomes. In our study, females were more frequently included ($n=80$, 57.14%) than males ($n=60$, 42.86%). This gender distribution is consistent with previous studies by Itani UD et al³, Legesse TK¹⁶, Rai GS et al¹⁷, and Salih HK¹⁸. Similarly, a study by Barzin et al in Imam Khomeini Hospital, which included patients with headache ($n=735$), reported a higher proportion of female (77%) than male.¹⁹

In the present study, the most commonly affected age group with chronic primary headaches was 31-40 years, followed by the 51-60 years age group. Conversely, this finding differs from that of Rai GS et al¹⁷, who reported the highest frequency in the 20-30 years age group, followed by the 30-40 years group. Likewise, Salih HK et al¹⁸ also observed a younger age distribution in their study. In contrast, Kaur A et al¹⁵ reported that the highest occurrence of chronic primary headaches was in the 41-50 years age group, followed by the 31-40 years group, due to the small size of their study, so the variation may be shifted. The mean age in our study was 45.19 ± 14.86 years, which is slightly higher than the mean age of 39.5 years reported by Itanyi UD et al.³ Furthermore, in this study, the majority of patients suffering from chronic primary headaches were referred by physicians for MRI scans from the outpatient department to exclude any significant intracranial abnormalities, even though they exhibited no neurological deficits; the most commonly

reported accompanying symptoms included nausea (72.86%), vomiting (65.71%), and neck pain (48.57%) (Table 1).

Moreover, this study aligns with the findings of Nayak S et al⁸, Kaur A et al¹⁵ and Legesse TK¹⁶, all of which emphasized that migraine is the most prevalent chronic primary headache disorder among patients experiencing persistent or daily headaches. In our study, migraine was the most frequent diagnosis with 65% of patients, followed by tension-type headaches 26.43% and cluster headaches 8.57%. These results support the view that migraine is the principal cause of chronic primary headaches and therefore, plays a prominent role in patient morbidity and use of healthcare resources, and early diagnosis and neuroimaging tailored for the chronic headache disorders. Among the samples evaluated in the current study, 67.14% presented with normal MRI findings, while 32.86% presented with abnormal findings. Notably, the most frequent abnormal MRI finding was paranasal sinusitis (22.86%), which aligns with the results reported by Salih HK et al¹⁸ (42%), Rai GS et al¹⁷ (58%), and Itanyi UD et al³ (21.3%). The distribution of other MRI findings in this study is also consistent with the study done by Ray-Offor OD et al⁹ and Itanyi UD et al³. One of the limitations of this study is that it is a cross-sectional analysis and thus, cannot determine cause-and-effect relationships.

The present study found that most parameters did not significantly correlate with the MRI findings. However, significant associations were noted between smoking and sinus polyposis ($p = 0.029$) and cluster headaches and neurodegenerative diseases ($p = 0.011$), as shown in Table 3. No significant associations were found between age groups (<40 and >40 years) and MRI findings, except for a near-significant trend between age >40 years and neurodegenerative disease ($p = 0.055$). All other MRI findings showed no significant differences between the age groups ($p > 0.05$) (table 4). This study contrasts with those conducted by Itanyi UD et al³, Salih HK et al¹⁸, and Alanazy MH et al²⁰, which reported significant associations with abnormal findings. Additionally, the results cannot be generalized to the entire population because these findings are confined to a single healthcare setting. Despite these limitations, this study offers baseline data on the significance of MRI in the diagnosis of pathological headaches.

CONCLUSION

The present study examined MRI findings in patients with chronic primary headache who were referred for evaluation. A predominance of female patients was observed. The most common abnormal MRI findings were sinusitis, neurodegenerative disorders and other abnormalities. MRI is the preferred imaging technique for chronic primary headaches, and patients with chronic primary headache should undergo clinical evaluation before being referred for an MRI. Therefore, evidence-based guidelines for neuroimaging are essential.

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CONFLICT OF INTEREST

None

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