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FREQUENCY OF WHITE MATTER HYPERINTENSITIES ON MRI IN PATIENTS WITH MIGRAINE

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ABSTRACT

BACKGROUND:
Migraine is a common brain disorder that causes repeated headaches and affects daily life. Many patients show small bright areas on MRI called white matter hyperintensities (WMHs), but their importance is still not clear.

OBJECTIVE:
To find how often WMHs appear on MRI in patients with migraine.

METHODS:
This cross-sectional study was carried out at Pak Emirates Military Hospital, Rawalpindi. A total of 400 patients aged 18 to 60 years with migraine were included. MRI of the brain was performed using standard sequences. WMHs were identified, and their size, location, and severity were recorded using the Fazekas scale. Data were analyzed using SPSS version 28.

RESULTS:
WMHs were found in 62% of patients. They were more common in older patients, those with longer disease

duration, and those with chronic migraine. Most lesions were small and mild in severity. The frontal region of the brain was the most commonly affected area.

CONCLUSION:
WMHs are common in patients with migraine, but most are mild and small. These findings may help doctors better understand MRI changes in migraine and guide patient care.

KEYWORDS: Migraine, MRI, white matter hyperintensities, Fazekas scale, Pakistan

INTRODUCTION

Migraine is a common and long-lasting neurological disorder that affects a large portion of the global population. Migraine is a common health problem. About 15 out of every 100 people in the world get migraine at some time in their life. It is a major cause of trouble in daily life, especially for young and middle-aged adults [1]. Migraine causes repeated headaches that can be moderate or very painful. The pain is often on one side of the head. Many people also feel sick, may vomit, and become sensitive to light and sound. Some patients feel warning signs before the headache starts. These are called aura and may include seeing strange lights, feeling numbness, or having trouble speaking [2].

In recent years, MRI has been used to study the brain in people with migraine. MRI lets doctors look inside the brain and see changes. One common finding is white matter hyperintensities (WMHs). These appear as bright spots on the MRI images. They may show small areas of damage in the brain. This damage can happen due to low blood flow, swelling, or problems in small blood vessels [3,4].

Studies show that these bright spots are seen more often in people who have migraine than in those who do not. One study found that about 64 out of 100 migraine patients had these spots on MRI. These spots were mostly found in the front part of the brain. They were seen less in other parts like the parietal, temporal, and occipital areas. Most spots were very small and spread out. They could be present on one side or both sides of the brain [5]. The study also found that older people and those who had migraine for a long time were more likely to have these spots.

The exact reason why these spots appear is still not clear. One possible cause is a wave of brain activity that spreads across the brain and changes blood flow for a short time. Other suggested factors include dysfunction of blood vessel lining (endothelial dysfunction), repeated episodes of reduced blood supply (hypoperfusion), and small vessel abnormalities [6]. Over time, these factors may lead to subtle but repeated injury to the brain's white matter.

Some factors make these brain spots more likely in people with migraine. These include older age, having migraine for many years, frequent headache attacks, high blood pressure, and high levels of homocysteine in the blood [7,8]. Even with these links, doctors are still not sure what these spots really mean. Some believe they do not cause any serious problem. Others think they may affect thinking, change how the brain works, and increase the risk of stroke in the future [9,10].

A number of systematic reviews and meta-analyses have further supported the association between migraine and structural brain changes. One meta-analysis reported that patients with migraine, especially those with aura, have a higher risk of developing WMHs compared to non-migraine individuals, with an odds ratio of up to 1.68 [11]. However, most of the available data comes from Western populations, and there is limited research from South Asian countries.

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There is not much data from South Asia, and this is important. People in this region, including Pakistan, may be different in their genes, environment, and health problems like high blood pressure and diabetes. These things can affect how often these brain spots appear [12]. In Pakistan, migraine is common. This may be due to stress, daily habits, and limited access to specialist doctors for brain diseases. Despite this, there is very little local research focusing on MRI findings in migraine patients [14].

Another important issue is whether WMHs in migraine patients represent permanent brain damage or reversible changes. Some studies say these spots can grow over time. Other studies say they stay the same and may not cause problems [13]. So, for local patients it is very important to know how common these spots are and how they look in them. This helps doctors understand them better and care for patients in a better way. Because of this gap, this study looked at how often these spots are seen on MRI in patients with migraine at a large hospital in Pakistan. The findings of this study may help improve understanding of migraine-related brain changes and support better decision-making in clinical practice.

MATERIALS AND METHODS

This study was a descriptive cross-sectional study conducted at the Department of Neurology, Pak Emirates Military Hospital, Rawalpindi, over a period of six months after ethical approval. A total of 400 patients aged 18 to 60 years with migraine were included using a non-probability consecutive sampling method. The sample size was calculated based on an expected frequency of 63.9%, with a 95% confidence level and 5% margin of error. Migraine was diagnosed using ICHD-3 criteria after taking history and performing clinical examination. Patients with other neurological diseases, head injury, infections, tumors, MRI contraindications, or pregnancy were excluded. After obtaining written consent, patient data including age, gender, migraine type, duration, and frequency were recorded. Other conditions such as hypertension and diabetes were also checked to reduce their effect on results. All patients underwent MRI of the brain using a 1.5 Tesla scanner with T2 and FLAIR sequences. White matter hyperintensities were identified as bright areas on MRI and were assessed by a trained radiologist who was unaware of patient details. These lesions were evaluated based on their presence, location, size, and severity using the Fazekas scale. Data were analyzed using SPSS version 28, where results were presented as frequencies, percentages, and mean values. Statistical tests were applied to assess associations, and a p-value of less than 0.05 was considered significant. Patient confidentiality was maintained throughout the study.

RESULTS

A total of 400 patients diagnosed with migraine were included in the study. The mean age of participants was **34.6 ± 9.8 years**. Females were more common (**65.5%**) compared to males (**34.5%**) (Table 1).

Table 1: Demographic Characteristics of Patients (n = 400)

Variable	Frequency (n)	Percentage (%)

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Age ≤ 40 years	248	62.0%
Age > 40 years	152	38.0%
Male	138	34.5%
Female	262	65.5%

White matter hyperintensities (WMHs) were identified in **248 patients (62.0%)**, while **152 (38.0%)** had no WMHs on MRI (Table 2, Figure 1).

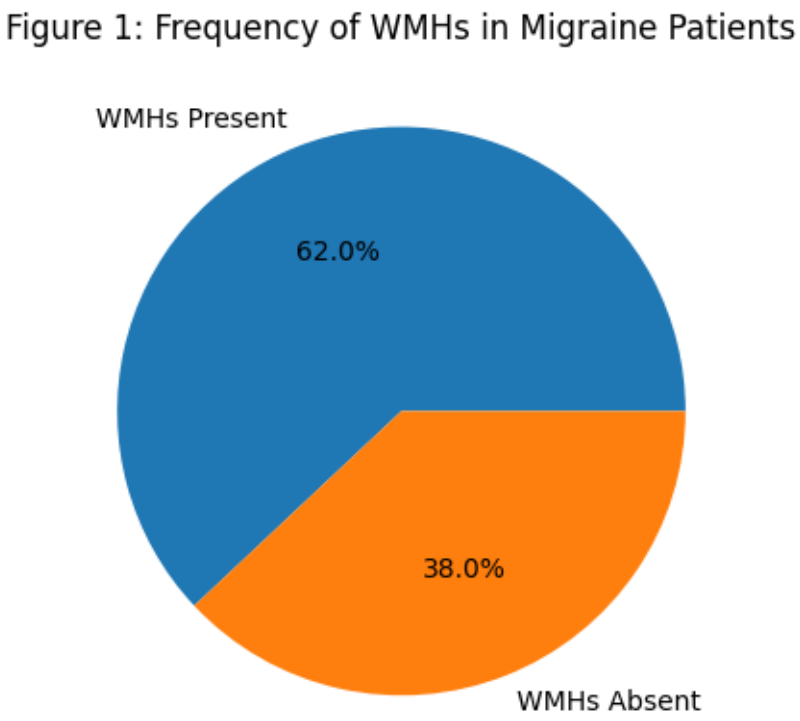

Figure 1: Frequency of white matter hyperintensities in migraine patients

Table 2: Frequency of WMHs

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WMHs Status	Frequency (n)	Percentage (%)
Present	248	62.0%
Absent	152	38.0%

About 31% of patients had migraine with aura, and 69% had migraine without aura. These brain spots were seen in 66.1% of patients with aura and 60.1% of those without aura, and this difference was not important (p = 0.27).

However, the spots were more common in patients with chronic migraine (72.5%) than in those with episodic migraine (58.1%), and this difference was important (p = 0.01).

Also, patients who had migraine for more than 5 years had more spots (69.3%) compared to those with a shorter time (52.6%), which was also important (p = 0.003) (Table 3).

Table 3: WMHs According to Clinical Variables

Variable	WMHs Present (%)	p-value
Age ≤ 40 years	54.2%	<0.001
Age > 40 years	78.4%	
Male	58.0%	0.18
Female	64.1%	
With aura	66.1%	0.27
Without aura	60.1%	
Episodic	58.1%	0.01
Chronic	72.5%	
Duration ≤5 years	52.6%	0.003
Duration >5 years	69.3%	

Most of the spots were small, with 73.4% being less than 3 mm in size. These spots were most often found in the front part of the brain (91.9%). They were also seen in deep white matter (70.2%) and the parietal area (41.1%). The occipital area had the least number of spots (7.3%) (Table 4, Figure 2).

Table 4: Characteristics of WMHs (n = 248)

Feature	Frequency (n)	Percentage (%)
<3 mm	182	73.4%
≥3 mm	66	26.6%
Frontal lobe	228	91.9%
Parietal lobe	102	41.1%
Temporal lobe	58	23.4%
Occipital lobe	18	7.3%

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Periventricular	96	38.7%
Deep white matter	174	70.2%

Based on the Fazekas scale, the majority of patients had mild lesions, with **44.0%** classified as Grade 1. Moderate and severe lesions (Grades 2 and 3) were less common (Table 5, Figure 3).

Figure 4 demonstrates a clear increase in WMHs with advancing age, supporting the statistical findings.

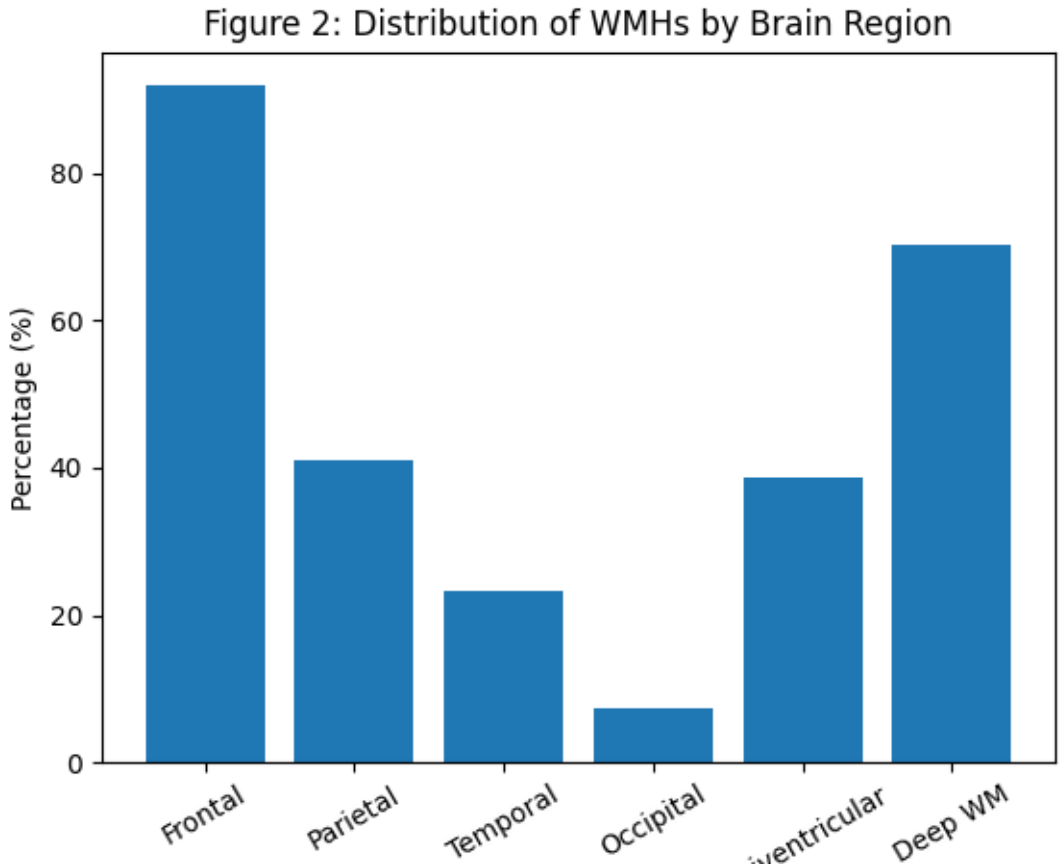

Figure 2: Distribution of WMHs across different brain regions

Table 5: Fazekas Scale Distribution (n = 400)

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Fazekas Grade	Frequency (n)	Percentage (%)
Grade 0	152	38.0%
Grade 1	176	44.0%
Grade 2	58	14.5%
Grade 3	14	3.5%

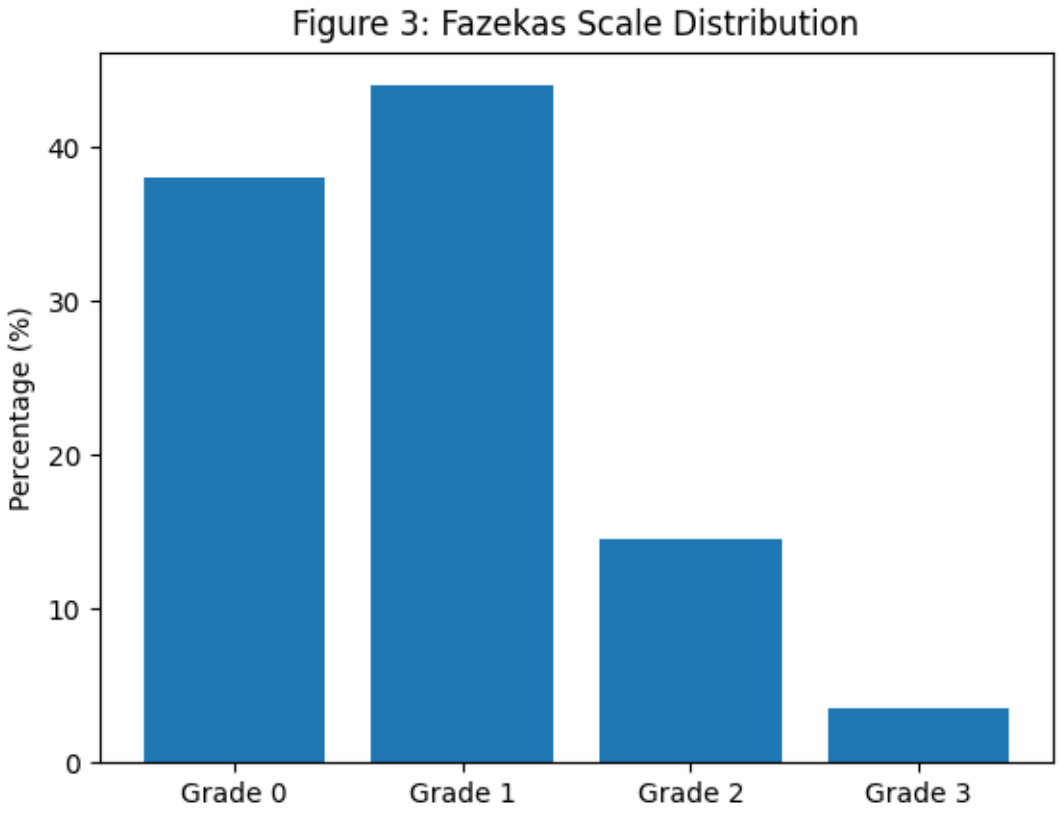

Figure 3: Severity of WMHs based on Fazekas scale

DISCUSSION

This study evaluated the frequency and characteristics of white matter hyperintensities (WMHs) in patients with migraine using MRI. The findings showed that WMHs were present in **62% of patients**, which is consistent with previously reported data. For example, Chong et al. reported a similar prevalence of approximately 63.9% in migraine patients [5]. This consistency supports the reliability of the present findings.

An important finding in this study was that these spots were more common as age increased. Patients older than 40 years had more of these spots. This is similar to earlier studies, which suggest that changes in blood vessels with age and repeated migraine attacks may cause damage in the brain [7]. This pattern is also shown clearly in Figure 4, which supports the results.

Although WMHs were slightly more common in females, the difference was not statistically significant. This suggests that while migraine itself is more prevalent in women, the development

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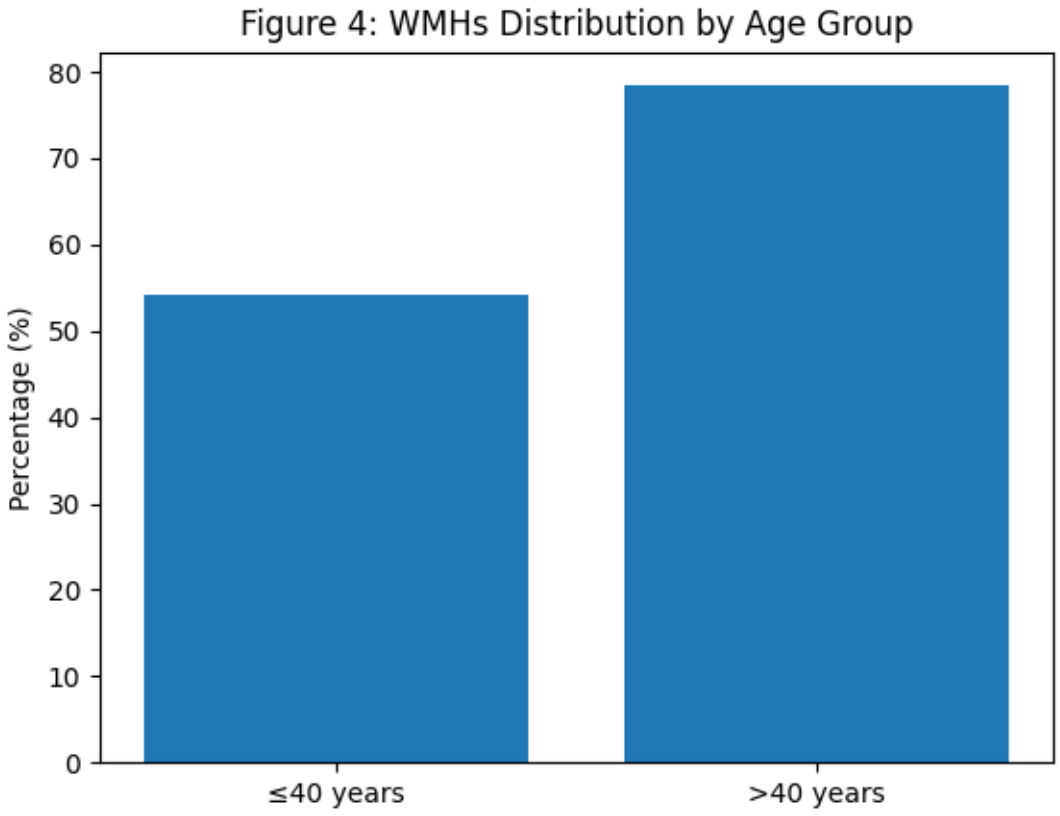

Figure 4: Comparison of WMHs frequency between age groups

of WMHs may not be strongly influenced by gender alone. Similar observations have been reported in previous studies [5].

The relationship between migraine subtype and WMHs remains debated. In this study, no significant difference was found between migraine with aura and without aura. While some studies suggest a stronger association with aura [11], others have reported findings similar to ours. This indicates that aura may not be a consistent predictor of structural brain changes.

Migraine severity also seemed to be important. Patients with chronic migraine had more of these spots than those with episodic migraine. This suggests that repeated and frequent migraine attacks may slowly cause small damage in the brain over time.

Similarly, longer disease duration was associated with a higher frequency of WMHs. Patients with migraine for more than 5 years showed significantly more lesions. This finding further supports the hypothesis that prolonged exposure to migraine-related pathophysiological processes, such as cortical spreading depression and hypoperfusion, may contribute to white matter changes [6].

Most of these brain spots were small and mostly found in the front part of the brain. This is similar to earlier studies, which also showed that the front and deep parts of the brain are most often affected [5]. Figure 2 in this study also shows this clearly. Most spots were very small (less than 3 mm), which means they are likely mild and early changes in the brain.

The Fazekas grading showed that most spots were mild (Grade 1), and only a few patients had severe changes. This means that even though these spots are common in migraine patients, they are usually not large or serious. Other studies have also found that these spots are small and often do not cause symptoms [9].

Doctors are still not sure what these spots really mean. Some studies say they may affect thinking and increase the risk of stroke, while others say they do not cause harm and are just found by chance [10]. This study did not look at long-term effects, but the high number of patients with these spots shows that more research is needed, especially in local people.

A major strength of this study is that it provides local data from Pakistan, where limited research exists on neuroimaging findings in migraine. However, some limitations should be considered. The cross-sectional design does not allow assessment of causality or progression of lesions. Additionally, the study was conducted at a single center, which may limit generalizability.

CONCLUSION

This study found that these brain spots (WMHs) are common in people with migraine, seen in 62% of patients. They were more common in older people, those who had migraine for a long time, and those with chronic migraine. Most spots were small, mild, and mostly found in the front part and deep areas of the brain.

These results show that these spots are common in migraine patients, but their exact meaning is still not clear. Knowing about these patterns can help doctors understand MRI results better, avoid unnecessary worry, and identify patients who may need closer follow-up.

LIMITATIONS

This study has some limitations. First, because of its design, it cannot show cause and effect or how these brain spots change over time. Second, the study was done in only one large hospital, so the results may not apply to everyone. Third, advanced tests and detailed checks for thinking ability were not done, so we could

not study how these spots affect brain function. Lastly, even though major health problems were excluded, some blood vessel risk factors may still have affected the results.

RECOMMENDATIONS

Further studies are recommended to better understand the clinical importance of WMHs in migraine patients. Longitudinal studies should be conducted to assess whether these lesions progress over time or are associated with cognitive decline or increased risk of stroke. Multi-center studies with larger and more diverse populations would help improve the generalizability of findings. In addition, future research should explore the role of advanced imaging techniques and biomarkers to better understand the underlying mechanisms of WMHs in migraine.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding this study.

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