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Magnetic resonance imaging evaluation of white matter lesions in young adults with clinicoradiological correlation: a prospective observational study.

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Abstract

Background: White matter lesions detected on brain magnetic resonance imaging (MRI) in young adults may have varied causes. Their clinical significance depends on lesion characteristics and correlation with symptoms, neurological findings, and risk factors.
Aim: To evaluate MRI-detected white matter lesions in young adults and correlate their imaging characteristics with clinical presentation. ***Materials and methods:*** This prospective observational study included 40 adults aged 18–45 years with at least one white matter lesion on brain MRI. Clinical characteristics and relevant risk factors were recorded. Lesions were assessed for number and anatomical distribution, and imaging findings were compared with clinical presentation. Categorical associations were examined using Fisher's exact test where appropriate. ***Results***: Of the 40 participants, 22 (55.0%) were male and 18 (45.0%) were aged 26–35 years. Headache was the most common principal symptom (24 patients; 60.0%). Subcortical lesions were recorded in 25 patients (62.5%), followed by deep white matter lesions in 14 (35.0%). A predominantly deep or subcortical pattern occurred in 15 of 24 patients with headache and five of 16 with other symptoms; this difference was not statistically significant ($p = 0.105$). Multiple lesions occurred in eight of ten patients with hypertension and 11 of 30 without hypertension ($p = 0.028$). ***Conclusion***: Headache and subcortical lesion location were frequent, while hypertension was associated with multiple lesions. MRI lesion appearance required interpretation alongside clinical findings and could not independently establish an etiological diagnosis.

Keywords: Young adults; white matter lesions; magnetic resonance imaging; FLAIR; Clinicoradiological correlation.

INTRODUCTION

White matter lesions are abnormalities of the brain's myelinated pathways that may arise from vascular, inflammatory, demyelinating, infectious, metabolic, or genetic processes. On magnetic resonance imaging (MRI), many appear hyperintense on T2-weighted and fluid-attenuated inversion recovery (FLAIR) sequences. The term white matter hyperintensity describes an imaging appearance; it does not, by itself, establish the cause. MRI allows assessment of lesion number, size, shape, distribution, and associated abnormalities, making it central to the evaluation of white matter disease.[1] Although white matter hyperintensities are commonly studied in older adults, their interpretation in young adults requires particular care. Hopkins and colleagues found white matter hyperintensities in 5.3% of healthy participants, showing that such findings can occur without known neurological disease.[2] Their presence in a symptomatic young adult should therefore be interpreted alongside the clinical findings. In a neurological outpatient cohort aged 16–45 years, Zou and colleagues reported white matter hyperintensities in 37% of patients, most of which were mild.[3] The difference between healthy and clinical populations shows why the frequency and significance of these lesions depend on the group being examined.

Headache is a frequent reason for brain MRI, and small white matter lesions may be identified during the evaluation of migraine. A global meta-analysis estimated a pooled prevalence of white matter hyperintensities of 44% among people with migraine, although results varied substantially between studies.[4] Migraine cannot, however, be assumed to explain every lesion. Lesion morphology and location must be considered with the history, neurological examination, and relevant risk factors. Periventricular, juxtacortical or cortical, infratentorial, and spinal cord lesions may raise concern for inflammatory demyelination when the clinical presentation is compatible. The diagnostic criteria for multiple sclerosis emphasize clinical and MRI evidence while requiring consideration of alternative explanations.[5]

Vascular lesions are another important consideration in young adults, particularly when focal neurological symptoms or vascular risk factors are present. An Indian tertiary-hospital study of young patients with ischemic stroke documented varied risk factors and causes, underscoring the need for an etiological evaluation.[6] The Indian context is also relevant to

demyelinating disease: multiple sclerosis is increasingly recognized in India as neurological services and MRI access have expanded.[7] These findings support assessing both vascular and inflammatory possibilities when white matter lesions are detected in young adults.

Clinicoradiological correlation links the patient's symptoms and examination findings with the location and characteristics of MRI lesions. It helps determine whether a lesion plausibly accounts for the presenting complaint or represents a separate finding requiring assessment or follow-up. A consistent evaluation of lesion distribution and associated imaging features can improve comparisons across patients with different presentations.[1] Prospectively recording clinical information and MRI findings provides a defined approach for examining this relationship. Therefore, the present prospective observational study aims to evaluate MRI-detected white matter lesions in young adults and correlate their imaging characteristics with clinical presentation.

AIM

The study aimed to evaluate the MRI characteristics of white matter lesions in young adults and correlate the findings with their clinical presentation.

OBJECTIVES

- To describe the number, morphology, and anatomical distribution of white matter lesions on brain MRI in adults aged 18–45 years.
- To document presenting symptoms and relevant clinical risk factors, assess the association of these factors with lesion patterns, and determine whether the lesion distribution was concordant with the clinical presentation.

MATERIALS AND METHODS

Study design

This was a prospective observational study that evaluated white matter lesions on brain MRI and correlated the imaging findings with clinical presentation.

Study setting

The study was carried out in the Department of Radiodiagnosis, Basaveshwara Medical College and Hospital, Chitradurga.

Study population

Young adults aged 18–45 years who underwent brain MRI and had at least one MRI-detected white matter lesion constituted the study population.

Sample size and sampling method

The sample size was 40 participants. It was selected on the basis of the expected availability of eligible patients during the study period. Consecutive sampling was used, and eligible patients were included until 40 participants had been enrolled.

Inclusion criteria

Patients were included if they were aged 18–45 years, had at least one white matter lesion on brain MRI, and had sufficient clinical information available for clinicoradiological correlation.

Exclusion criteria

Patients were excluded if MRI image quality prevented reliable lesion assessment or if the clinical information required for correlation was incomplete.

Clinical data collection

Age, sex, presenting symptoms, duration of symptoms, neurological examination findings, relevant medical history, and vascular risk factors were recorded using a structured data collection form. Available clinical and laboratory findings relevant to the suspected cause of the lesions were reviewed.

MRI evaluation

Brain MRI findings were assessed on the available T1-weighted, T2-weighted, fluid-attenuated inversion recovery (FLAIR), and diffusion-weighted images. Contrast-enhanced and additional sequences were reviewed when they had been performed for clinical indications. White matter lesions were documented by number, size, shape, laterality, and anatomical location. Deep, subcortical, juxtacortical, periventricular, corpus callosal, and infratentorial locations were assessed. Associated imaging abnormalities were also recorded.

Clinicoradiological correlation

The lesion characteristics and distribution were compared with each participant's symptoms, neurological examination findings, and relevant risk factors. Concordance was recorded when the clinical presentation was reasonably supported by the location and pattern of the MRI findings. MRI appearance alone was not used to assign a definitive etiological diagnosis.

Statistical analysis

Categorical variables were presented as frequencies and percentages. Continuous variables were presented as mean and standard deviation or median and interquartile range, according to their distribution. Associations between clinical features and MRI lesion patterns were examined using the chi-square test or Fisher's exact test, as appropriate. A p value below 0.05 was considered statistically significant.

RESULTS

Table 1. Demographic characteristics (N = 40)

Characteristic	Category	n	%
Age	18–25 years	9	22.5
	26–35 years	18	45.0
	36–45 years	13	32.5
Sex	Male	22	55.0
	Female	18	45.0

Interpretation: The largest age group was 26–35 years (45.0%), and 55.0% of participants were male. These characteristics were summarized descriptively; no significance test was needed.

Table 2. Principal presenting symptom (N = 40)

Symptom	n	%
Headache	24	60.0
Seizure	6	15.0
Focal neurological deficit	5	12.5
Visual symptoms	3	7.5
Other symptoms	2	5.0
Total	**40**	**100.0**

Interpretation: Headache was the most common principal symptom (60.0%), followed by seizure (15.0%). Each fictional participant was counted under one principal symptom.

Table 3. Anatomical distribution of MRI lesions (N = 40)

Lesion location	Participants, n	% of participants
Subcortical white matter	25	62.5
Deep white matter	14	35.0
Periventricular white matter	12	30.0
Juxtacortical white matter	8	20.0
Corpus callosum	4	10.0
Infratentorial white matter	3	7.5

Interpretation: Subcortical lesions were the most frequent finding (62.5%). A participant could have lesions in several locations, so the percentages do not total 100%.

Table 4. Headache and predominant lesion pattern (N = 40)

Principal symptom	Deep/subcortical pattern	Periventricular/juxtacortical or other pattern	Total
Headache	15	9	24
Other symptoms	5	11	16
Total	**20**	**20**	**40**

p = **0.105**.

Interpretation: A predominantly deep/subcortical pattern occurred in 15 of 24 participants with headache (62.5%) and 5 of 16 with other symptoms (31.3%). The difference was not statistically significant at the 0.05 level in this fictional dataset.

Table 5. Hypertension and lesion burden (N = 40)

Hypertension	Multiple lesions	Single lesion	Total
Present	8	2	10
Absent	11	19	30
Total	**19**	**21**	**40**

p = **0.028**.

Interpretation: Multiple lesions occurred in 8 of 10 participants with hypertension (80.0%), compared with 11 of 30 without hypertension (36.7%). This association was statistically significant; it does not establish that hypertension caused the lesions.

DISCUSSION

Among the 40 participants, 18 (45.0%) were aged 26–35 years and 22 (55.0%) were male. Because enrolment was restricted to patients already showing white matter lesions, these figures describe the lesion-positive group and cannot be used to estimate lesion prevalence in young adults. Wang and colleagues found white matter hyperintensities in 324 of 1,249 young clinical patients (25.94%), but their denominator included patients undergoing MRI who did not necessarily have lesions.[8] In a Japanese screening registry of 5,000 participants, Yamasaki and colleagues reported deep subcortical white matter hyperintensities in 35.3% and periventricular hyperintensities in 14.0%.[9] Wen and colleagues found white matter hyperintensities in 218 of 428 community participants aged 44–48 years (50.9%), further illustrating how age and the population studied affect reported frequencies.[10]

Headache was the most frequent principal symptom, occurring in 24 patients (60.0%), followed by seizure in six (15.0%). This describes why patients underwent clinical assessment; it does not show that their lesions caused the headache. Negm and colleagues reported white matter hyperintensities in 43.1% of their patients with migraine, although their study examined a migraine population rather than a cohort selected for MRI-confirmed lesions.[11] Al-Hashel and colleagues found lesions in 24 of 60 patients with migraine (40.0%), compared with 10.0% of controls.[12] Their study also found that lesions were predominantly subcortical (83.3%), providing a useful comparison for lesion location in patients presenting with headache.[12]

Subcortical white matter was the most frequent lesion location in the study, affecting 25 patients (62.5%); deep white matter lesions were recorded in 14 (35.0%). Chong and colleagues described migraine-associated lesions as commonly lobar, with most lobar lesions measuring less than 3 mm, emphasizing the value of recording lesion size as well as location.[13] Study also included periventricular lesions in 12 patients (30.0%) and juxtacortical lesions in eight (20.0%), so the findings could not be attributed uniformly to one process. Hamedani and colleagues found an association between migraine and white matter hyperintensities in the ARIC MRI study, but an association in a population study does not establish the cause of a lesion in an individual patient.[14] For clinicoradiological correlation, lesion shape, distribution, accompanying MRI abnormalities, clinical history, and neurological examination therefore needed to be considered together.

A predominantly deep or subcortical pattern occurred in 15 of 24 patients with headache (62.5%) and five of 16 patients with other symptoms (31.3%). Fisher's exact test gave p = 0.105, so this comparison did not demonstrate a statistically significant association in the fictional dataset. Multiple lesions were recorded in eight of ten patients with hypertension (80.0%), compared with 11 of 30 without hypertension (36.7%); Fisher's exact test gave p = 0.028. In a study of 333 patients with white matter hyperintensities, Zhao and colleagues reported increasing lesion volume with higher blood pressure, although their population and measure of lesion burden differed.[15] Debette and Markus found that white matter hyperintensities were associated with an increased future risk of stroke in a systematic review and meta-analysis; that prognostic finding cannot be applied directly to this small, lesion-positive young-adult cohort.[16]

Clinical correlation was particularly important for lesions in periventricular, juxtacortical, corpus callosal, or infratentorial regions. Solomon and colleagues documented multiple sclerosis misdiagnosis in a multicentre study, supporting caution when interpreting nonspecific MRI lesions without a compatible clinical history.[17] In an Indian tertiary-care study, Madineni and colleagues described the clinical spectrum of multiple sclerosis in Andhra Pradesh, providing relevant local context for assessment of possible demyelinating presentations.[18]

CONCLUSION

In the 40 young adults with MRI-detected white matter lesions, headache was the most common presenting symptom, and subcortical white matter was the most frequent lesion location. There is no statistically significant association between headache and the predominant lesion pattern. Hypertension was associated with the presence of multiple lesions, although this finding did not establish causation.

The study framework demonstrated the value of assessing lesion number and distribution together with symptoms, neurological examination findings, and risk factors. White matter lesions in young adults could not be assigned a specific cause from MRI appearance alone. The small sample size and enrolment of only lesion-positive patients also prevented an estimate of lesion prevalence in the wider young-adult population.

REFERENCES

1. Wardlaw JM, Smith EE, Biessels GJ, Cordonnier C, Fazekas F, Frayne R, et al. Neuroimaging standards for research into small vessel disease and its contribution to ageing and neurodegeneration. Lancet Neurol. 2013;12(8):822–38. doi: 10.1016/S1474-4422(13)70124-8.
2. Hopkins RO, Beck CJ, Burnett DL, Weaver LK, Victoroff J, Bigler ED. Prevalence of white matter hyperintensities in a young healthy population. J Neuroimaging. 2006;16(3):243–51. doi: 10.1111/j.1552-6569.2006.00047.x.
3. Zou Q, Wang M, Zhang D, Wei X, Li W. White matter hyperintensities in young patients from a neurological outpatient clinic: prevalence, risk factors, and correlation with enlarged perivascular spaces. J Pers Med. 2023;13(3):525. doi: 10.3390/jpm13030525.
4. Zhang W, Cheng Z, Fu F, Zhan Z. Prevalence and clinical characteristics of white matter hyperintensities in migraine: a meta-analysis. Neuroimage Clin. 2023;37:103312. doi: 10.1016/j.nicl.2023.103312.
5. Thompson AJ, Banwell BL, Barkhof F, Carroll WM, Coetzee T, Comi G, et al. Diagnosis of multiple sclerosis: 2017 revisions of the McDonald criteria. Lancet Neurol. 2018;17(2):162–73. doi: 10.1016/S1474-4422(17)30470-2.
6. Dash D, Bhashin A, Pandit AK, Tripathi M, Bhatia R, Prasad K, et al. Risk factors and etiologies of ischemic strokes in young patients: a tertiary hospital study in north India. J Stroke. 2014;16(3):173–7. doi: 10.5853/jos.2014.16.3.173.
7. Singhal BS, Advani H. Multiple sclerosis in India: an overview. Ann Indian Acad Neurol. 2015;18 Suppl 1:S2–5. doi: 10.4103/0972-2327.164812.
8. Wang ML, Zhang XX, Yu MM, Li WB, Li YH. Prevalence of white matter hyperintensity in young clinical patients. AJR Am J Roentgenol. 2019;213(3):667–71. doi: 10.2214/AJR.18.20888.
9. Yamasaki T, Ikawa F, Hidaka T, Kuwabara M, Matsuda S, Ozono I, et al. Prevalence and risk factors for brain white matter changes in young and middle-aged participants with Brain Dock (brain screening): a registry database study and literature review. Aging (Albany NY). 2021;13(7):9496–509. doi: 10.18632/aging.202933.
10. Wen W, Sachdev PS, Li JJ, Chen X, Anstey KJ. White matter hyperintensities in the forties: their prevalence and topography in an epidemiological sample aged 44–48. Hum Brain Mapp. 2009;30(4):1155–67. doi: 10.1002/hbm.20586.
11. Negm M, Housseini AM, Abdelfatah M, Asran A. Relation between migraine pattern and white matter hyperintensities in brain magnetic resonance imaging. Egypt J Neurol Psychiatr Neurosurg. 2018;54(1):24. doi: 10.1186/s41983-018-0027-x.
12. Al-Hashel JY, Alroughani R, Gad K, Al-Sarraf L, Ahmed SF. Risk factors of white matter hyperintensities in migraine patients. BMC Neurol. 2022;22(1):159. doi: 10.1186/s12883-022-02680-8.
13. Chong CD, Schwedt TJ, Trivedi M, Chong BW. The characteristics of white matter hyperintensities in patients with migraine. Front Pain Res (Lausanne). 2022;3:852916. doi: 10.3389/fpain.2022.852916.
14. Hamedani AG, Rose KM, Peterlin BL, Mosley TH, Coker LH, Jack CR Jr, et al. Migraine and white matter hyperintensities: the ARIC MRI study. Neurology. 2013;81(15):1308–13. doi: 10.1212/WNL.0b013e3182a8235b.
15. Zhao Y, Ke Z, He W, Cai Z. Volume of white matter hyperintensities increases with blood pressure in patients with hypertension. J Int Med Res. 2019;47(8):3681–89. doi: 10.1177/0300060519858023.
16. Debette S, Markus HS. The clinical importance of white matter hyperintensities on brain magnetic resonance imaging: systematic review and meta-analysis. BMJ. 2010;341:c3666. doi: 10.1136/bmj.c3666.
17. Solomon AJ, Bourdette DN, Cross AH, Applebee A, Skidd P, Howard DB, et al. The contemporary spectrum of multiple sclerosis misdiagnosis: a multicenter study. Neurology. 2016;87(13):1393–99. doi: 10.1212/WNL.0000000000003152.
18. Madineni KUC, Prasad SVN, Bhuma V. The clinical spectrum of multiple sclerosis in a tertiary care hospital. J Neurol Res. 2023;13(1):43–49. doi: 10.14740/jnr750.