Section: Radiology

Original Research Article

# PREVALENCE OF WHITE MATTER HYPERINTENSITIES IN ELDERLY PATIENTS WITH COGNITIVE COMPLAINTS: AN MRI-BASED OBSERVATIONAL STUDY

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## Abstract

**Background:** White matter hyperintensities (WMHs) on magnetic resonance imaging (MRI) are common in the elderly and have been associated with cognitive decline. Understanding their prevalence and association with vascular risk factors is critical for early identification and management of cognitive impairment. Objectives: To determine the prevalence, type, and severity of WMHs in elderly patients presenting with cognitive complaints and to assess their association with vascular risk factors. **Material and Methods:** This observational, cross-sectional study included 100 elderly participants (aged ≥ 60 years) presenting with cognitive complaints at a tertiary care center. Brain MRI scans were analyzed for the presence, type (periventricular, deep white matter, or both), and severity (graded by Fazekas scale) of WMHs. Clinical data including age, sex, history of hypertension, and diabetes mellitus were collected and analyzed. **Results:** WMHs were present in 78% of the participants. Among these, periventricular WMHs were observed in 61.5%, deep white matter WMHs in 51.3%, and both types in 38.5%. Based on Fazekas grading, 38.5% had mild, 35.9% moderate, and 25.6% severe WMHs. A significant association was found between increasing age and WMH severity ($p < 0.05$). Hypertension was significantly associated with moderate to severe WMHs ($p < 0.01$), while diabetes showed a non-significant trend ($p = 0.08$). No sex-based difference in WMH prevalence was noted. **Conclusion:** There is a high prevalence of WMHs among elderly individuals with cognitive complaints, with significant association to age and hypertension. Routine MRI evaluation may aid in early risk stratification and targeted intervention.

## INTRODUCTION

Cognitive decline represents a mounting public health concern globally, particularly in aging populations, as the prevalence of neurodegenerative disorders such as Alzheimer's disease continues to rise.[1,2] Among the neuroimaging markers frequently observed in elderly individuals with cognitive complaints are white matter hyperintensities (WMHs)—areas of increased signal intensity on T2-weighted and fluid-attenuated inversion recovery (FLAIR) MRI sequences. These lesions, indicative of small vessel ischemic damage, demyelination, or gliosis, are widely recognized as imaging biomarkers of cerebral small vessel disease (CSVD) and are increasingly used in clinical and research settings for assessing cerebral microvascular pathology.[3,4]

The clinical significance of WMHs extends beyond structural changes. Several studies have established associations between WMH burden and impairments in cognitive domains such as attention, processing speed, executive function, and global cognition.[2,5] Notably, WMHs are predictive of progression from mild cognitive impairment to dementia, underscoring their role in the early stages of neurodegeneration.[1,6] Furthermore, WMH topography—particularly when localized in parietal or frontal regions—has been shown to correlate with distinct patterns of cognitive dysfunction in both Alzheimer's disease and cerebral amyloid angiopathy.[5,6]

Despite global advances in neuroimaging, variability persists in reported WMH prevalence due to differences in imaging protocols, grading scales, and population characteristics.[4] In India and other low- and middle-income countries (LMICs), research on WMHs remains limited. In particular, the prevalence and severity of WMHs in elderly individuals with cognitive symptoms—and their association with common vascular risk factors like hypertension and diabetes—are underexplored in local clinical contexts, despite the known contributions of these conditions to CSVD pathophysiology.[2,3]

This study aims to determine the prevalence, type, and severity of WMHs in elderly patients with cognitive complaints using MRI, and to evaluate their association with vascular risk factors, thereby contributing to early detection strategies and informed clinical decision-making in aging populations.

## MATERIALS AND METHODS

**Study Design and Setting**

This was a hospital-based observational cross-sectional study conducted at the Department of Radiology, Osmania General Hospital, Hyderabad, a tertiary care teaching hospital. The study period extended from January 2023 to December 2023.

**Study Population:**

The study included elderly patients aged 60 years and above who presented with cognitive complaints such as memory loss, disorientation, attention deficits, or difficulty in performing daily activities. All participants were referred for MRI evaluation of the brain as part of their clinical work-up.

**Inclusion Criteria:**

Patients aged ≥ 60 years

Presenting with subjective or clinically observed cognitive complaints

Willing to undergo MRI brain scan

Provided informed consent

**Exclusion Criteria:**

History of stroke, brain tumor, or major psychiatric illness

Previous diagnosis of neurodegenerative disease (e.g., Alzheimer's or Parkinson's disease)

MRI contraindications (e.g., pacemaker, metallic implants)

**Sample Size:**

A total of 100 patients meeting the inclusion criteria were enrolled through consecutive sampling.

**Data Collection:**

Demographic data (age, sex), clinical history (including presence of hypertension and diabetes mellitus), and MRI findings were recorded. Brain MRIs were performed using a standard 1.5 Tesla scanner(GE Company), and WMHs were assessed on T2-weighted and FLAIR sequences.

**Radiological Assessment:**

WMHs were categorized based on location into:

**Periventricular WMHs**

**Deep white matter WMHs**

**Both types**

Severity of WMHs was graded using the Fazekas scale:

Grade 1: Mild

Grade 2: Moderate

Grade 3: Severe

**Statistical Analysis:**

Descriptive statistics were used to summarize demographic and clinical variables. Chi-square test was applied to evaluate associations between WMH severity and vascular risk factors (hypertension, diabetes). A p-value of $< 0.05$ was considered statistically significant. Data analysis was performed using SPSS version 25.0.

**Ethical Considerations:**

Ethical clearance was obtained from the Institutional Ethics Committee of Osmania General Hospital, Hyderabad. Written informed consent was obtained from all participants prior to inclusion in the study.

## RESULTS

A total of 100 elderly patients (aged ≥ 60 years) presenting with cognitive complaints were included in the study. Among these, 52% were male and 48% were female. The mean age of participants was 69.4 ± 6.7 years (Table 1).

Magnetic Resonance Imaging (MRI) revealed that white matter hyperintensities (WMHs) were present in 78% of the participants (n = 78), while 22% showed no detectable WMHs (Table 2). Among those with WMHs, periventricular hyperintensities were observed in 61.5% (n = 48), deep white matter hyperintensities in 51.3% (n = 40), and both types concurrently in 38.5% (n = 30) (Table 3).

The severity of WMHs, graded using the Fazekas scale, showed that 38.5% (n = 30) had mild WMHs (Grade 1), 35.9% (n = 28) had moderate (Grade 2), and 25.6% (n = 20) had severe WMHs (Grade 3) (Table 4).

A statistically significant association was observed between advancing age and higher Fazekas grades ($p < 0.05$). However, no significant gender-based difference in WMH prevalence was found ($p = 0.48$). Further analysis indicated that patients with a history of hypertension (n = 54) exhibited a significantly higher frequency of moderate to severe WMHs (Grades 2 and 3) compared to those without hypertension ($p < 0.01$). Although a higher prevalence of WMHs was also noted among diabetic patients (n = 38), the association did not reach statistical significance ($p = 0.08$) (Table 5).


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| Table 1: Demographic Distribution of Study Participants (N = 100) | |
|---|---|
| **Category** | **Value** |
| Total Patients | 100 |
| Male | 52 |
| Female | 48 |
| Mean Age (years) | 69.4 ± 6.7 |

| Table 2: Presence of White Matter Hyperintensities (WMHs) | | |
|---|---|---|
| **WMH Status** | **Number of Patients** | **Percentage** |
| Present | 78 | 78% |
| Absent | 22 | 22% |

| Table 3: Type of WMHs among Affected Patients (n = 78) | | |
|---|---|---|
| **Type of WMH** | **Number of Patients** | **Percentage** |
| Periventricular | 48 | 61.5% |
| Deep White Matter | 40 | 51.3% |
| Both Types | 30 | 38.5% |

| Table 4: WMH Severity Based on Fazekas Scale (n = 78) | | |
|---|---|---|
| **Fazekas Grade** | **Number of Patients** | **Percentage** |
| Grade 1 (Mild) | 30 | 38.5% |
| Grade 2 (Moderate) | 28 | 35.9% |
| Grade 3 (Severe) | 20 | 25.6% |

| Table 5: WMH Severity by Risk Factors | | |
|---|---|---|
| **Risk Factor** | **Moderate to Severe WMHs (n)** | **p-value** |
| Hypertension | 34 | < 0.01 |
| No Hypertension | 14 | – |
| Diabetes | 22 | 0.08 |
| No Diabetes | 26 | – |

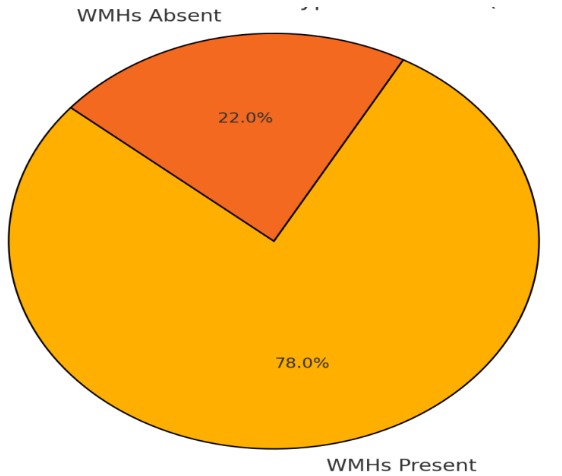


**Figure No 1: Presence of White Matter Hyperintensities (WMHs)**

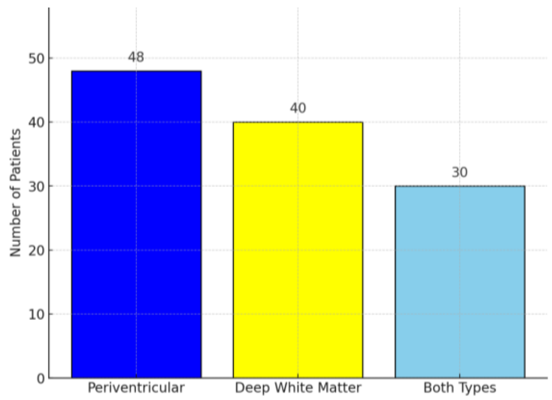


**Figure No 2: Type of WMHs Among Affected Patients**

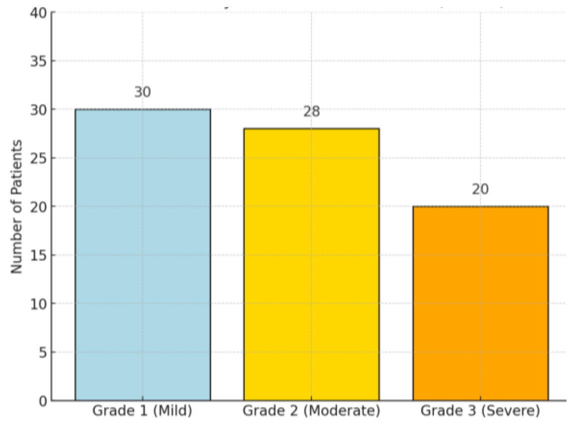


**Figure No 3: WMH Severity Based on Fazekas Scale**

## DISCUSSION

This study assessed the prevalence, distribution, and severity of white matter hyperintensities (WMHs) in elderly patients with cognitive complaints and explored their association with vascular risk factors. The overall prevalence of WMHs in our cohort was 78%, aligning with previous reports that indicate a high burden of WMHs in aging populations, particularly among those with cognitive decline (de Leeuw et al., 2001).[9]

We observed that periventricular and deep white matter regions were frequently affected, with 38.5% of patients showing both types. This distribution is consistent with the underlying pathophysiology of cerebral small vessel disease, where chronic ischemic injury contributes to diffuse white matter damage (Garnier-Crussard et al., 2020).[10] The majority of affected individuals (over 60%) had moderate to severe WMHs as per the Fazekas scale, suggesting a significant clinical burden. This supports prior evidence demonstrating that increased WMH burden correlates with cognitive deficits, particularly in processing speed, attention, and executive function (Brickman et al., 2011).[13]

A significant association was noted between advancing age and WMH severity ($p < 0.05$), corroborating findings from both population-based and imaging studies that demonstrate WMH prevalence and volume increase with age (Zhuang et al., 2018; Kramer et al., 2007).[8,7] This age-related trend emphasizes the cumulative effect of vascular and metabolic insults on white matter integrity across the lifespan (Moura et al., 2019).[12]

Hypertension showed a strong and statistically significant relationship with moderate to severe WMHs ($p < 0.01$), highlighting its established role in the pathogenesis of cerebral small vessel disease. Although patients with diabetes mellitus showed a higher prevalence of WMHs, the association was not statistically significant in our study, potentially due to sample size limitations. Similar observations have been reported in prior studies, where hypertension appeared as a stronger predictor of WMH burden than other metabolic factors (Guo & Shi, 2022).[11]

Unlike some earlier reports suggesting sex-based differences in WMH distribution or cognitive outcomes, our study found no significant gender association ($p = 0.48$), echoing findings that sex differences may be minimal or confounded by other variables such as age or comorbidities (Moura et al., 2019).[12]

These findings reinforce the utility of MRI in detecting WMHs in elderly patients with cognitive complaints and suggest that early identification of WMH burden—especially in individuals with vascular risk factors—may offer an opportunity for preventive interventions. Regular cognitive screening and aggressive management of hypertension in this population could potentially mitigate progression to dementia (Kramer et al., 2007; Garnier-Crussard et al., 2020).[7,10]

Limitations of the study include its cross-sectional design, which prevents causal inferences, and the lack of standardized neurocognitive assessments to correlate WMH burden with specific cognitive domains. Additionally, the sample was drawn from a single tertiary hospital, which may limit the generalizability of findings.

## CONCLUSION

This study highlights a high prevalence (78%) of white matter hyperintensities (WMHs) among elderly patients presenting with cognitive complaints, with a significant proportion showing moderate to severe involvement. Periventricular and deep white matter regions were most commonly affected. Increasing age and hypertension were strongly associated with greater WMH severity, emphasizing the role of vascular risk factors in cerebral small vessel disease. Although diabetes showed a positive trend, it was not statistically significant. Routine brain MRI in elderly individuals with cognitive symptoms may aid in early identification of cerebral microvascular changes, enabling timely intervention to manage modifiable risks and potentially delay the progression of cognitive decline.

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