# White matter hyperintensity

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White matter hyperintensity (WMH) refers to abnormal areas of increased signal intensity seen on magnetic resonance imaging (MRI) within the white matter of the brain. The white matter of the brain consists of nerve fibers covered in myelin, a fatty substance that helps transmit nerve signals. Normally, white matter appears as a uniform, low-intensity signal on MRI. When areas of the white matter become hyperintense (brighter) on MRI, it may indicate various underlying conditions or pathologies. Here are some key points about white matter hyperintensity:

Appearance on MRI: On T2-weighted or FLAIR (Fluid-Attenuated Inversion Recovery) MRI sequences, white matter hyperintensities appear as bright, white or light-gray regions. They contrast with the darker appearance of normal white matter.

Causes:

Small Vessel Disease: One of the most common causes of white matter hyperintensity is small vessel disease. It occurs due to damage or dysfunction in the small blood vessels of the brain. Conditions such as hypertension, diabetes, and aging are associated with small vessel disease. Ischemia: White matter hyperintensity can result from chronic cerebral ischemia, where insufficient blood flow to the brain over time causes damage to white matter. Inflammatory Conditions: Some inflammatory conditions, such as multiple sclerosis (MS), can also cause white matter hyperintensity. Infection: Certain infections of the central nervous system can lead to white matter abnormalities. Other Neurological Disorders: Conditions like leukodystrophies and leukoencephalopathies are characterized by white matter abnormalities. Aging: As people age, small white matter hyperintensities are relatively common, but their significance depends on their extent and location. Clinical Significance: The presence and extent of white matter hyperintensity on MRI can vary. While some individuals may have small, inconsequential areas of hyperintensity, others may have more extensive lesions. Extensive white matter hyperintensity may be associated with cognitive impairment, gait disturbances, and an increased risk of stroke.

Management: Management of white matter hyperintensity depends on the underlying cause. For conditions like hypertension or diabetes, controlling these risk factors can help slow the progression

of white matter hyperintensity. In cases of multiple sclerosis or other specific neurological disorders, treatments are targeted at the underlying condition.

Monitoring: In some cases, doctors may recommend regular MRI scans to monitor the progression of white matter hyperintensity and assess its impact on the patient's neurological health.

Research: White matter hyperintensity is an active area of research in neurology and neuroimaging. Researchers are working to better understand the causes and consequences of these abnormalities and develop more targeted treatments.

In summary, white matter hyperintensity on MRI is a radiological finding that can be associated with various underlying conditions, most commonly small vessel disease and cerebral ischemia. Its clinical significance and management depend on the extent and underlying cause, and it is an important area of study in neurology and neuroimaging.

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Data show that WMHs are associated with a decline in perceptual speed rather than episodic or semantic memory and that cognitive change is more vulnerable to WMH accumulations in deep and periventricular regions [1)]

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Findings provide converging evidence that WMH is a leading vascular contributor to dementia risk, which may better capture the brain damage caused by BP (and other etiologies) than BP itself and should be targeted as a priority for dementia prevention in the population [2)]

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White matter hyperintensities (WMHs) are brain white matter lesions that are hyperintense on fluid-attenuated inversion recovery (FLAIR) magnetic resonance imaging (MRI) scans. Larger WMH volumes have been associated with Alzheimer's disease (AD) and with cognitive decline.

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The association of white matter hyperintensity burden with amyloid positivity and conversion to dementia in people with mild cognitive impairment (MCI) is unclear. The aim of the study was to expand on this research by examining whether a change in white matter hyperintensity burden over time differs in amyloid-negative (Aβ-) and amyloid-positive (Aβ+) people with MCI who either remain stable or convert to dementia. To examine this question, they compared regional white matter hyperintensity burden in four groups: amyloid positive (Aβ+) progressor, amyloid negative (Aβ-) progressor, amyloid positive (Aβ+) stable, and amyloid negative (Aβ-) stable.

Participants with MCI from the Alzheimer's Disease Neuroimaging Initiative were included if they had APOE ε4 status and if amyloid measures were available to determine amyloid status (i.e., amyloid positive, or amyloid negative). Participants with a baseline diagnosis of MCI, had APOE ε4 information, and amyloid measures were included. An average of 5.7 follow-up time points per participant were included, with a total of 5054 follow-up time points with a maximum follow-up duration of 13 years. Differences in total and regional white matter hyperintensity burden were examined using linear mixed-effects models.

A total of 820 participants (55-90 years of age) were included in the study (Aß+ Progressor, n= 239;

Aß- Progressor, n= 22; Aß+ Stable, n= 343; Aß- Stable, n= 216). People who were Aß- stable exhibited reduced baseline white matter hyperintensities compared to Aß+ progressors and Aß+ stable at all regions of interest (β belongs to [.20 -.33], CI belongs to [.03 -.49], p<.02), except Deep white matter hyperintensities. When examining longitudinal results, compared to Aß- stable, all groups had steeper accumulation in white matter hyperintensity burden with Aß+ progressors (β belongs to [-.03-.06], CI belongs to [-.05-.09], p<.01) having the largest increase (i.e., largest increase in white matter hyperintensity accumulation over time).

These results indicate that white matter hyperintensity accumulation contributes to conversion to dementia in older adults with mild cognitive impairment who are amyloid-positive and negative people [3)].

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The relationship between WMH volumes and cross-sectional cognitive measures has been inconsistent. Tubi et al. hypothesized that this inconsistency may arise from 1) the presence of AD-specific neuropathology that may obscure any WMH effects on cognition, and 2) varying criteria for creating a WMH segmentation. Manual and automated programs are typically used to determine segmentation boundaries, but criteria for those boundaries can differ. It remains unclear whether WMH volumes are associated with cognitive deficits, and which segmentation criteria influence the relationships between WMH volumes and clinical outcomes. In a sample of 260 non-demented participants (ages 55-90, 141 males, 119 females) from the Alzheimer's Disease Neuroimaging Initiative (ADNI), we compared the performance of five WMH segmentation methods, by relating the WMH volumes derived using each method to both clinical diagnosis and composite measures of executive function and memory. To separate WMH effects on cognition from effects related to AD-specific processes, we performed analyses separately in people with and without abnormal cerebrospinal fluid amyloid levels. WMH volume estimates that excluded more diffuse, lower-intensity lesions were more strongly correlated with clinical diagnosis and cognitive performance, and only in those without abnormal amyloid levels. These findings may inform best practices for WMH segmentation, and suggest that AD neuropathology may mask WMH effects on clinical diagnosis and cognition [4)].

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White matter hyperintensities (WMH) are among the most prominent structural changes observed in older adulthood. These changes coincide with functional changes to the intrinsic network organization of the aging brain. Yet little is known about how WMH are associated with changes to the whole-brain functional connectome in normal aging. We used a lesion prediction algorithm to quantify WMH as well as resting-state multiecho functional magnetic resonance imaging to characterize resting-state functional connectivity in a cross-sectional sample of healthy older adults (N = 105, 60-83 years of age). In a multivariate analysis, we found that higher lesion load was associated with a global pattern of network dedifferentiation, marked by lower within- and greater between- network connectivity. Network specific changes included greater visual network integration and greater posterior-anterior connectivity. The relationship between WMH and resting-state functional connectivity was negatively associated with fluid IQ as well as Blood Oxygen Level Dependent signal dimensionality. Reduced functional network segregation is a widely observed pattern of age-related change. Our findings show that these functional changes are associated with the accumulation of WMH in older adulthood [5)].

1)

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