# White Matter Matters:
## New Understanding of MRI “Spots” in Normals

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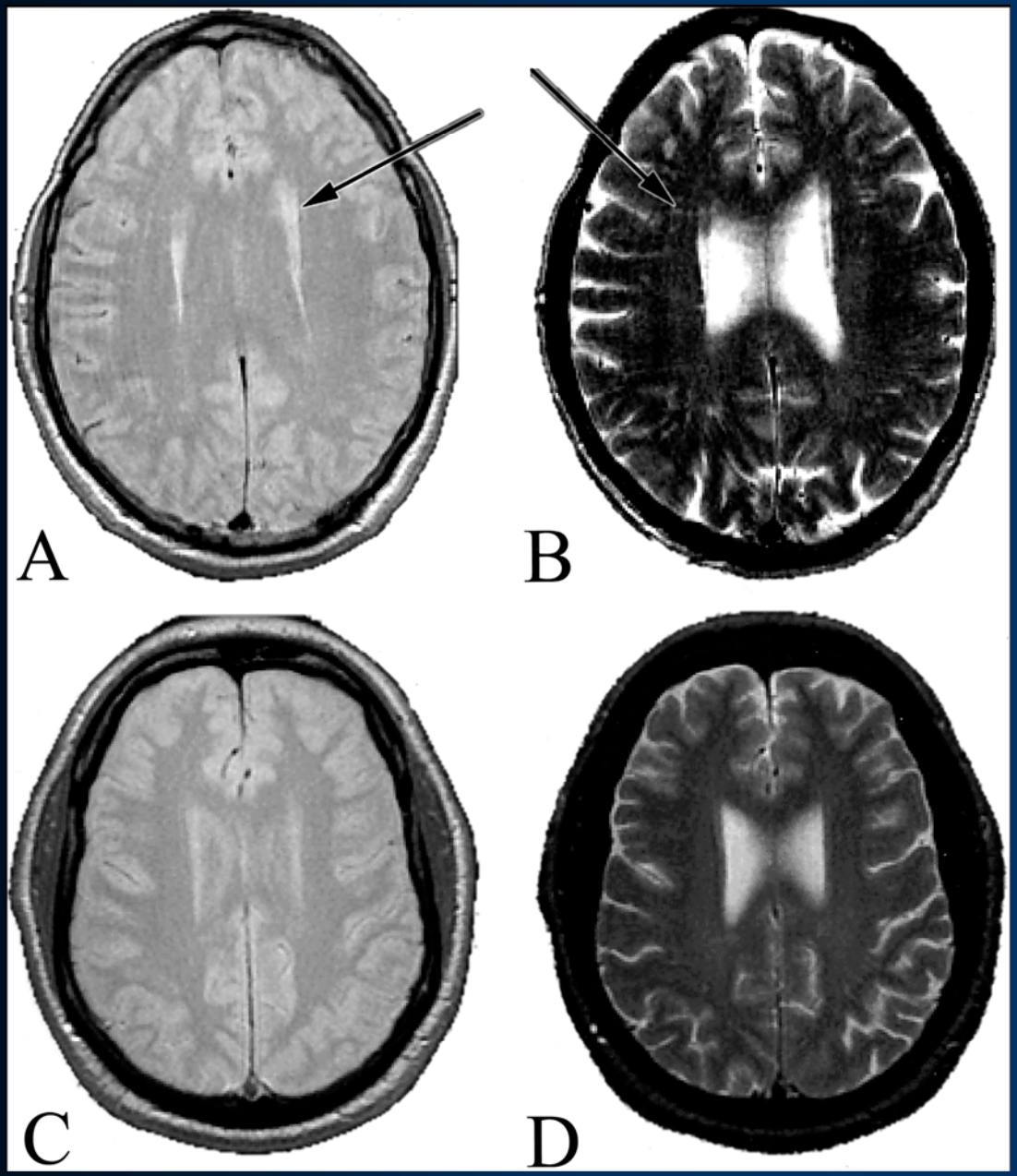
# White Matter Hyperintensities

- Bright objects or “spots” in white matter on MRI
  - Ischemia, microvascular damage/leak, inflammation, scar
  - Often reported as “normal,” may be pathological
    - Relationships to HTN, stroke, dementia, bipolar disorder, depression, Parkinson’s disease, cerebral ischemia, CO poisoning
  - Prevalence increases with age, but timing and significance unclear



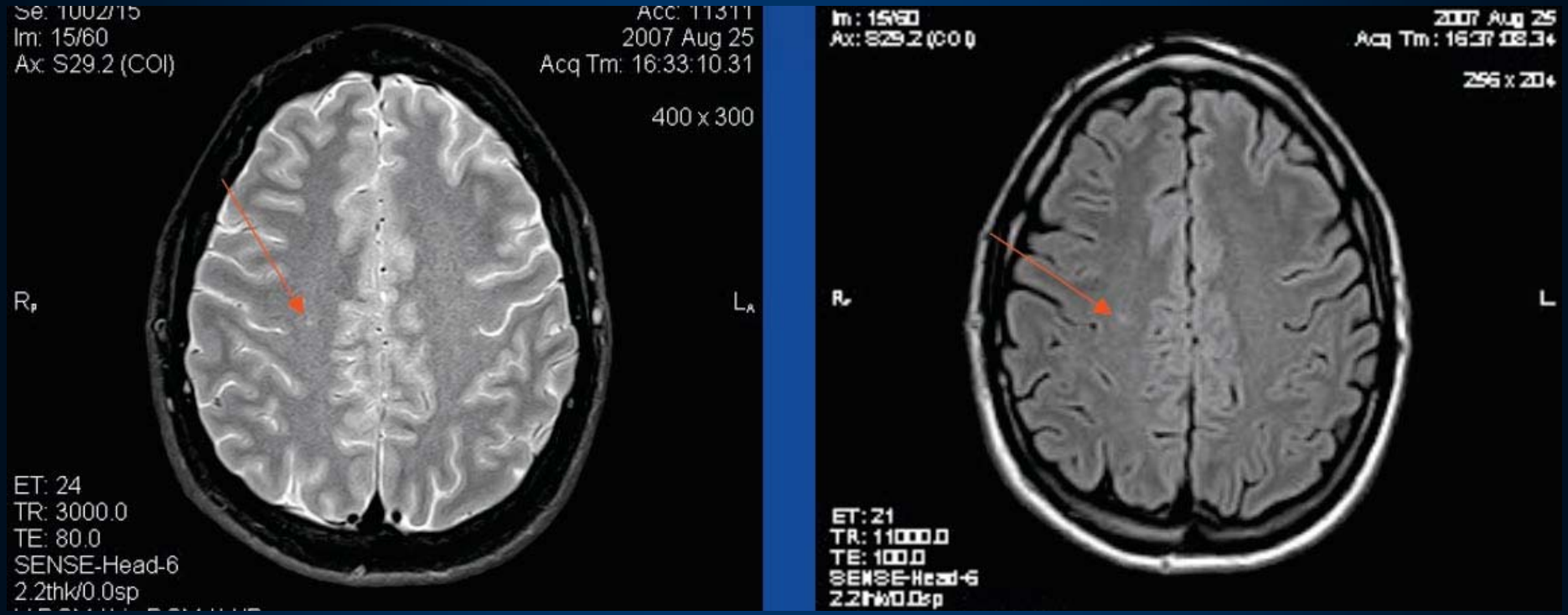

# CO poisoning, T2-hyperintensities

## Normal

Parkinson RB, Hopkins RO, Cleavinger HB, Weaver LK, Victoroff J, Foley JF, Bigler ED.White matter hyperintensities and neuropsychological outcome following carbon monoxide poisoning.Neurology. 2002 May 28;58(10):1525-32.

# WMH after CO Poisoning

- In order to see a WMH on a 1.5T clinical scan, the involved volume equals 100 million cells.



# WMH Literature Review

- 22 studies 1984-2003 reporting WMH in "normals"
  - N = 27 to 3301 subjects
  - Reported incidence 0.5%-99%
  - All but 4 articles reported comorbid factors: dementia, diabetes, stroke, MS, cardiac disease, HTN, depression, alcohol abuse, CHF, cancer
- Of 4 studies enrolling subjects without comorbid factors, reported prevalence 0.5%-8%

# WMH in “Normals”

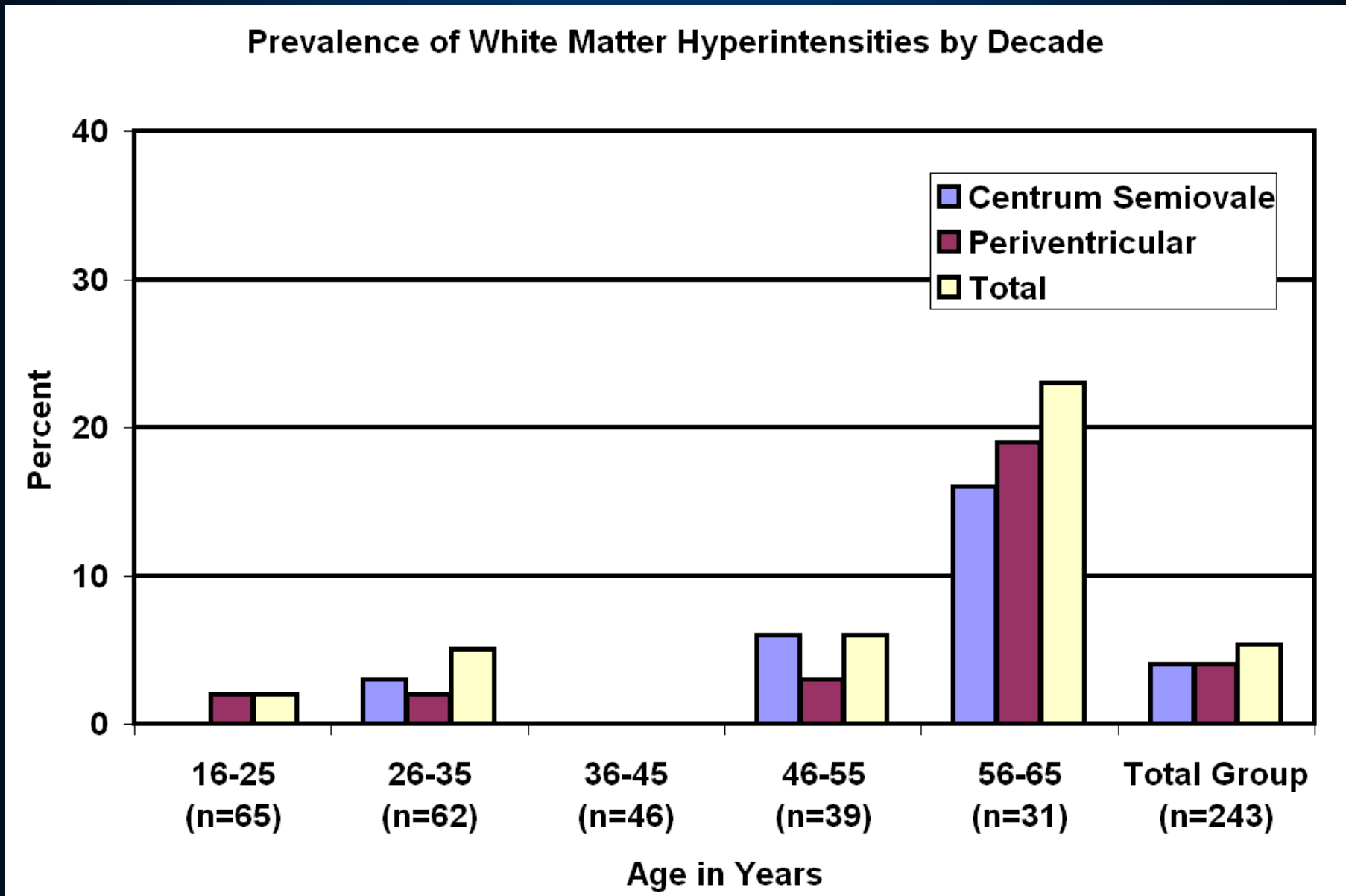
- 243 healthy subjects (122 M, 121 F)
- Age 37±13 years (range 16-65)
- Excluded subjects with a history of: head injury w/LOC, neuro disorders, diabetes, CV disease, cardiac surgery, HTN, alcohol or drug abuse
- 1.5 Tesla MRI

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 Jul;16(3):243-51.

# WMH Rating

- WMH rated by 2 raters blind to age and gender
- T2-weighted and proton density images
- Visual 4-point semi-quantitative scale
  - Standard scale (0,1,2)
  - Victoroff scale (0,0.5,1,2)
    - 0: none
    - 0.5: ≤ standard #1
    - 1: > standard #1 but ≤ standard #2
    - 2: > standard #2

# WMH Prevalence



# WMH Prevalence

- WMH in 13/243 subjects (5.3%)
- All WMH small except in 1 subject
- No gender differences (P=0.8)
- Age >55 had a 10-fold increase in prevalence compared to age ≤55 (P<0.001)
- Consistent with other studies of subjects with no comorbid medical disorders
  - Figiel 1991 (6%) and Brown 1992 (8%)

# WMH and Future Decline

- WMH associated with loss of “brain reserve”
  - Cognitive decline as WMH progress
  - Degree of WMH independently related to post-stroke cognitive decline
  - Increased risk for dementia, including Alzheimers
- Will slowing the rate of WMH progression improve prognosis?

# Further Reading


1. Smith EE, et al. Magnetic resonance imaging white matter hyperintensities and brain volume in the prediction of mild cognitive impairment and dementia. Arch Neurol. 2008 Jan;65(1):94-100.
2. Steffens DC, et al. Longitudinal magnetic resonance imaging vascular changes, apolipoprotein E genotype, and development of dementia in the neurocognitive outcomes of depression in the elderly study. Am J Geriatr Psychiatry. 2007 Oct;15(10):839-49.
3. Kramer JH, et al. Longitudinal MRI and cognitive change in healthy elderly. Neuropsychology. 2007 Jul;21(4):412-8.
4. Burton EJ, et al. Progression of white matter hyperintensities in Alzheimer disease, dementia with lewy bodies, and Parkinson disease dementia: a comparison with normal aging. Am J Geriatr Psychiatry. 2006 Oct;14(10):842-9.
5. Mungas D, et al. Longitudinal volumetric MRI change and rate of cognitive decline. Neurology. 2005 Aug 23;65(4):565-71.
6. Garde E, et al. Decline in intelligence is associated with progression in white matter hyperintensity volume. J Neurol Neurosurg Psychiatry. 2005 Sep;76(9):1289-91.
7. Mungas D, et al. Volumetric MRI predicts rate of cognitive decline related to AD and cerebrovascular disease. Neurology. 2002 Sep 24;59(6):867-73.
8. Mirsen TR, et al. Clinical correlates of white-matter changes on magnetic resonance imaging scans of the brain. Arch Neurol. 1991 Oct;48(10):1015-21.