Cardiovascular Risk Factors Predict the Spatial Distribution of White Matter Hyperintensities

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BACKGROUND

White Matter Hyperintensities (WMH) are brain white matter regions with high intensity on T2 or FLAIR MRI.

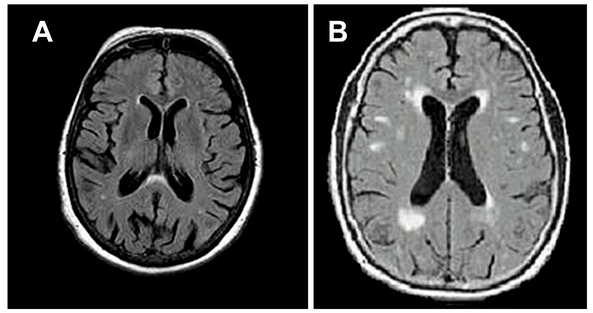

Figure 1: FLAIR MRI of a brain without WMH **(A)** and one with WMH **(B)**

WMH volume is associated with numerous cardiovascular risk factors

- Hypertension
- Diabetes
- Hypercholesterolemia

There is evidence in the literature that certain regions of the brain are more associated with a specific risk factor.

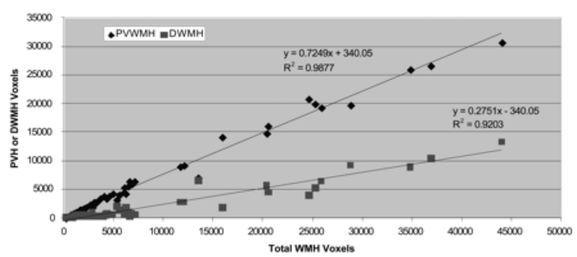

Figure 2: Deep vs. Periventricular WMH in the Brain (DeCarli et al. 2005)

SIGNIFICANCE

A subject's WMH spatial distribution may indicate which risk factors are responsible for white matter injury.

Risk factors responsible for WMH present a target for aggressive medical management.

PURPOSE

1. To create a map of every individual brain voxel that was significantly associated with a specific risk factor (hypertension, diabetes, hypercholesterolemia).
2. To compare the distributions of risk factor associated WMH regions to determine which brain regions are uniquely associated with a risk factor.

METHODS

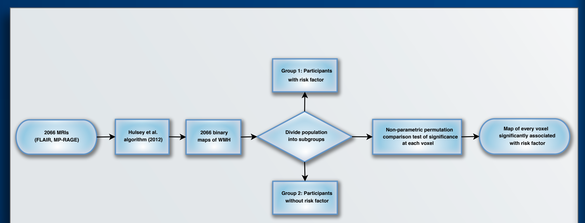

Figure 3: Overall Study Design

- 2066 MRI brains were obtained from the Dallas Heart Study II, a representative sample of Dallas county.
- Each MRI was analyzed using a prior automated algorithm that generated each patient's WMH distribution plotted onto a standard template.
- For each risk factor, the population was divided into a risk factor group and a non-risk factor group.
- Each voxel was compared between the two groups using a nonparametric permutation test.
- A map of every voxel significantly associated with each risk factor was created.

RESULTS

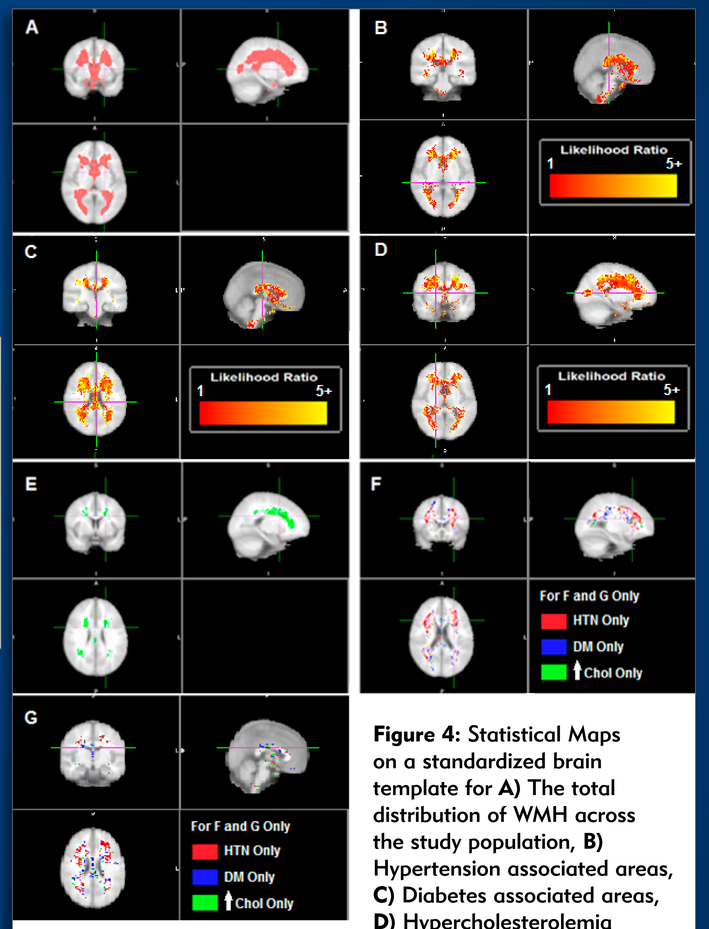

Figure 4: Statistical Maps on a standardized brain template for **A)** The total distribution of WMH across the study population, **B)** Hypertension associated areas, **C)** Diabetes associated areas, **D)** Hypercholesterolemia associated areas, **E)** Areas associated with all three risk factors, **F)** Areas only associated with 1 risk factor, **G)** Areas only associated with 1 risk factor (second cross-section)

Table 1

	Number of Voxels	Percent of Total WMH Distribution
Total Distribution of WMH Across Study Population	431891	100%
Hypertension Associated	64998	15.0%
Diabetes Associated	59592	13.8%
Hypercholesterolemia Associated	34900	8.1%
Hypertension Associated Only	26064	6.0%
Diabetes Associated Only	22527	5.2%
Hypercholesterolemia Associated Only	8088	1.9%
Associated with all three risk factors	15593	3.6%
No association with any risk factor	331588	76.8%

Number of Statistically Significant Risk Factor Associated Voxels

RESULTS (continued)

- Hypertension was associated with frontal lobe WMH (see Figure 4-F).
- Diabetes is associated with WMH in the corpus callosum (see Figure 4-G).
- All three risk factors were associated with the areas around the anterior and posterior horns of the lateral ventricles (see Figure 4-E).

CONCLUSIONS

- Each risk factor (hypertension, diabetes, hypercholesterolemia) has a unique spatial WMH distribution.
- Knowing a risk factor's WMH distribution will improve specificity in evaluating risk factor associated white matter injury.

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ACKNOWLEDGEMENTS

We would like to thank the Doris Duke Foundation and staff for their support and the Dallas Heart Study Investigators and staff for their help in obtaining the data used in these studies.