

Distance from main arteries is associated with microstructural and functional brain tissue characteristics

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BACKGROUND

The distribution of major arteries on the cortical surface opens a question whether nutrient and oxygen supply in areas more distant is as effective as in their proximity. Possible tissue vulnerabilities in areas that are more distant from major arteries may be reflected by subtle alterations in microstructural and functional properties.

METHODS

116 healthy, non-demented volunteers underwent MRI acquisition to extract microstructural and functional metrics, specifically adiabatic T1rho and T2rho as markers of cellularity and iron, relaxation along the fictitious field, rank 4 (RAFF4) as a marker of myelination, intracellular volume fraction – a metric based on a biological tissue model derived from diffusion weighted scans and two resting-state MRI metrics – degree centrality as a measure of general connectivity and fractional amplitude of low-frequency fluctuations describing general neural activity. Regional gradients of the above-stated metrics were correlated to a map of Euclidean distance to the nearest major artery (see Figure 1).

RESULTS

All the employed metrics exhibited very significant correlations with the distance to the nearest artery (p values after False Discovery Correction well below 0.001). The strong clustering of individual datapoints, mostly for T1rho, T2rho and RAFF, shows high homogeneity of the finding across the studied population.

CONCLUSION

This study provides the first indication of arterial distance as an important element affecting microstructural and functional measures both in grey and white matter. Our findings show substantial gradients in myelination, iron content and cellularity related to the distance to the nearest main arterial trunk. Furthermore, both functional metrics yielded direct correlation with the arterial distance, pointing to distinct cerebral organisation with gradients of grey matter connectivity and general activity.

Figure 1:

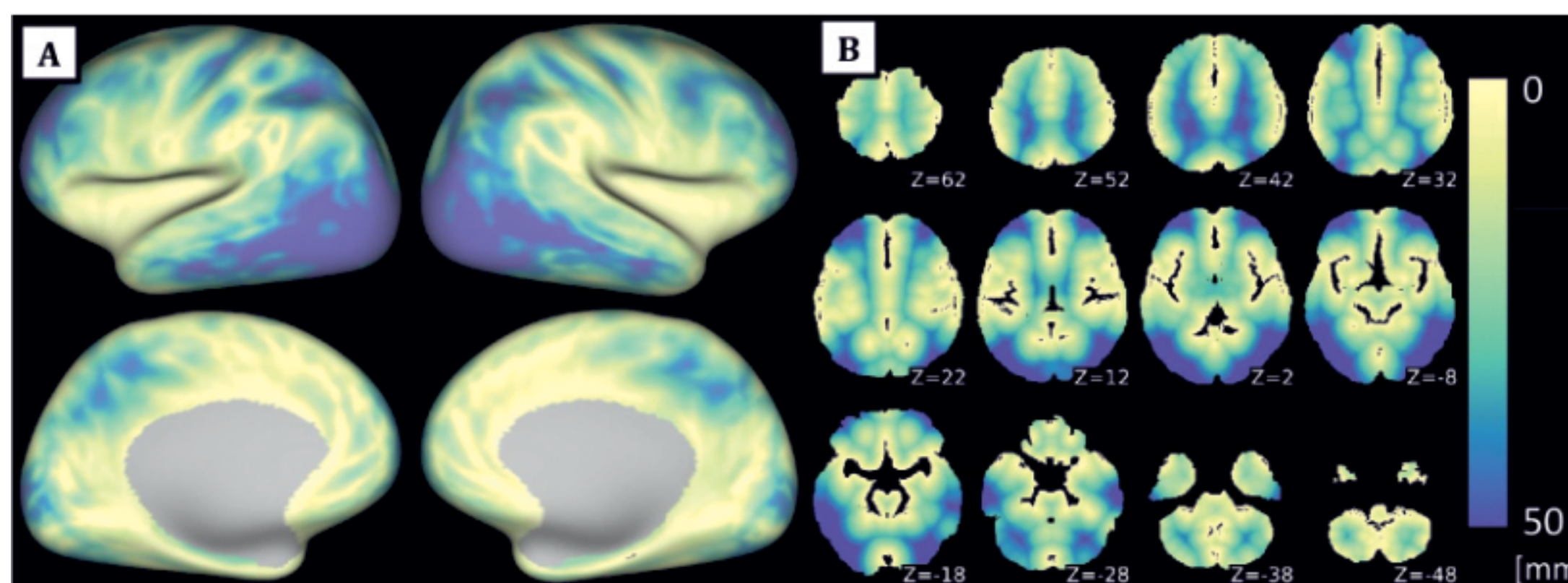


Figure 2:

