

[EP07.27] Fetal brain connectomics at 33 weeks reveals asymmetric and parietal-dominant connectivity patterns

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Background

Fetal brain connectomics, derived from diffusion MRI and tractography, enables in vivo assessment of white matter organization during prenatal life.

Mapping these evolving networks can enhance our understanding of typical brain maturation and provide a framework for identifying early neurodevelopmental alterations.

Objective

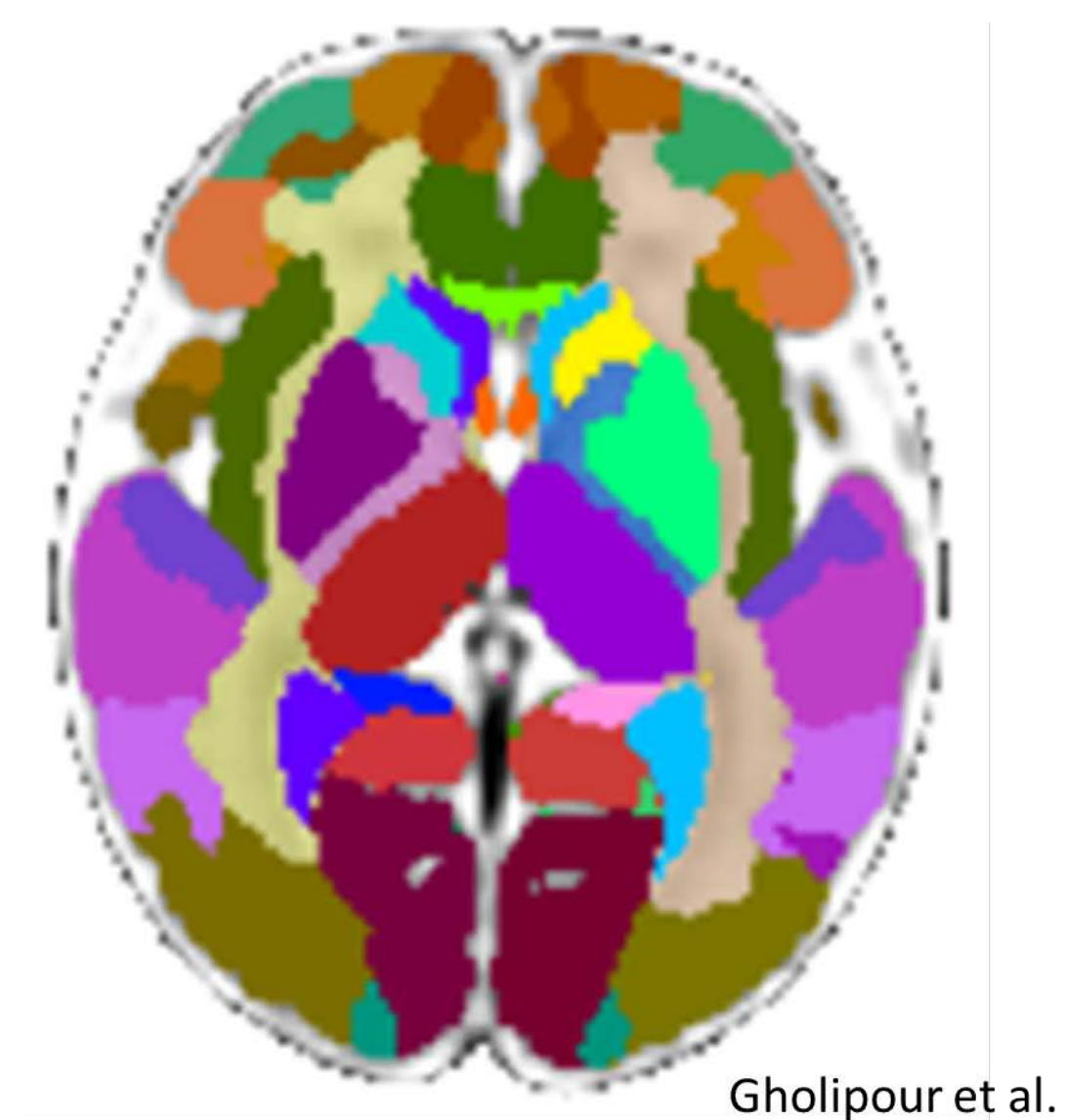
To explore fetal structural connectivity patterns at 33 weeks of gestation using diffusion tensor imaging (DTI) and whole-brain tractography.

Methods

A 30-year-old woman with an unremarkable pregnancy was prospectively included in a research protocol (LUMIERE on the FETUS – NCT04142606). Fetal MRI was acquired at 33 weeks using a 1.5T scanner and including 15 directions DTI acquisition

Post-processing was performed with MRtrix3, including denoising, motion correction, and tractography using a constrained spherical deconvolution model.

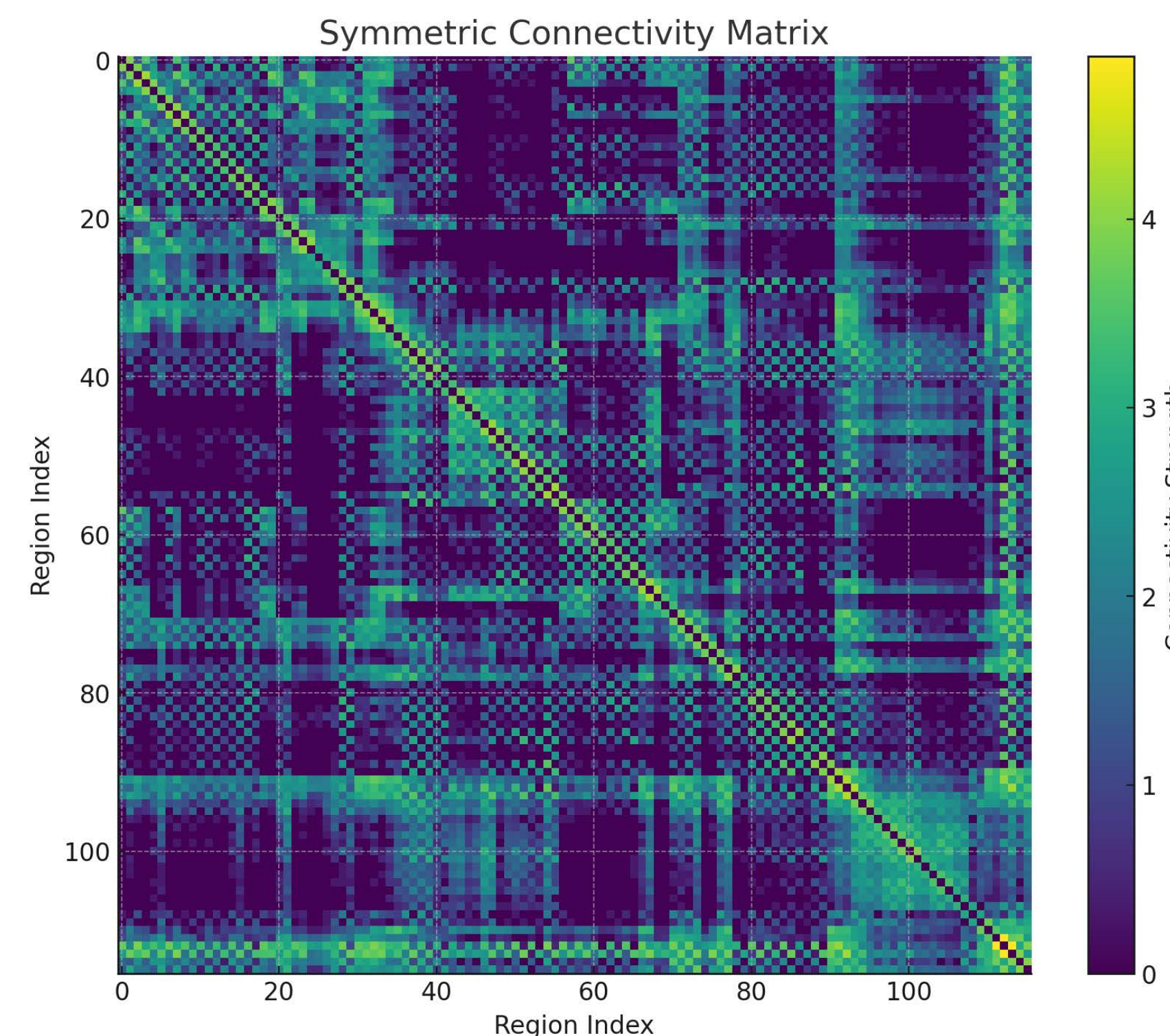
A 125-region fetal brain atlas was used for parcellation and connectome generation. Connectivity matrices were computed using streamline count, with optional weighting by length and fractional anisotropy.



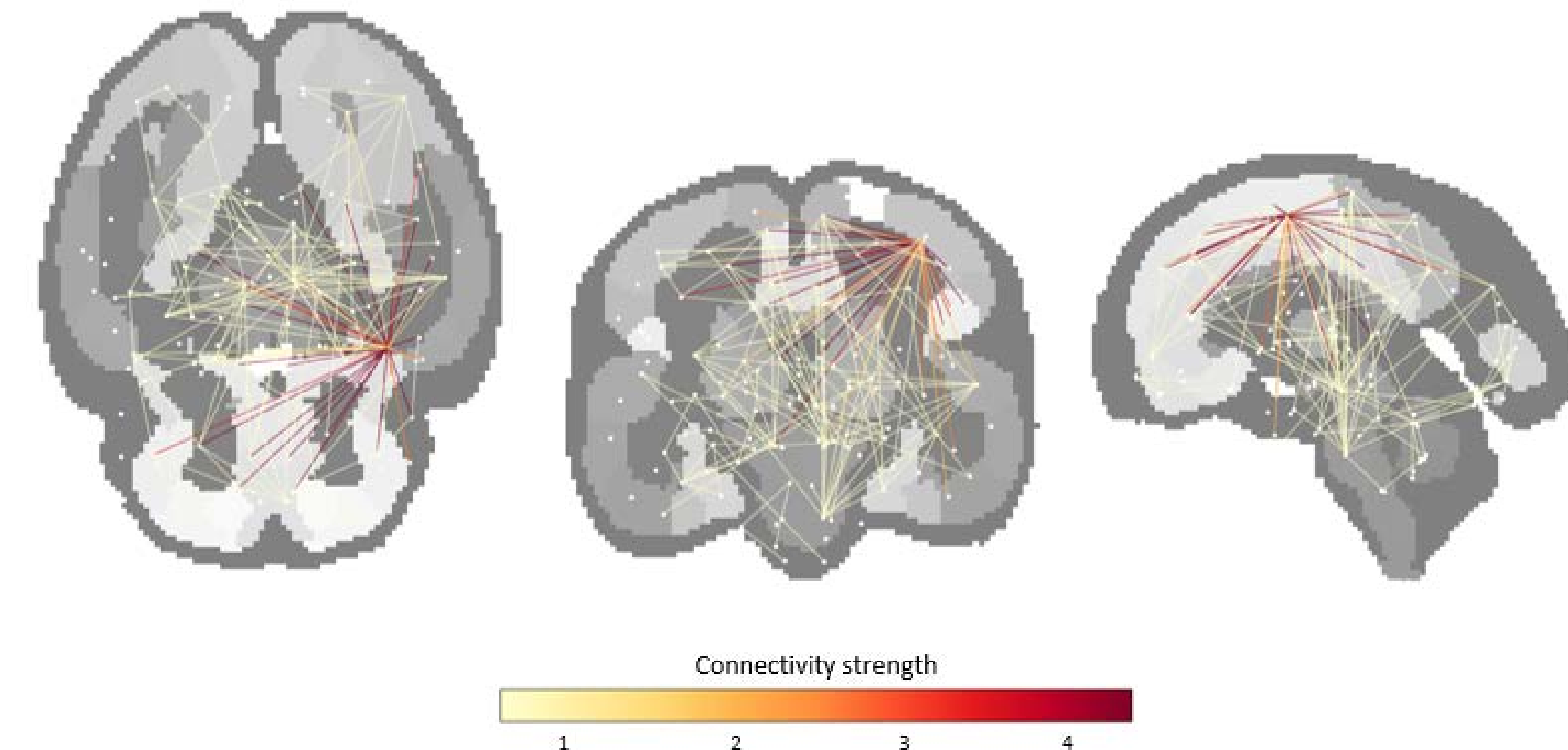
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Results

We successfully reconstructed the structural connectome at 33 weeks:



Each dot represents the connectivity strength between 2 brain regions.



Three main findings were noted:

- (1) an **asymmetry** in connectivity strength favoring the left hemisphere, aligning with known postnatal asymmetries;
- (2) **prominent parietal lobe connectivity**, suggesting early maturation of sensorimotor integration pathways;
- (3) **dense interlobar connections** involving parieto-frontal and parieto-occipital regions, consistent with the expected development of associative white matter tracts.

Conclusion

Fetal connectomics at 33 weeks demonstrates asymmetric and regionally organized connectivity, with a prominent role of the parietal cortex.