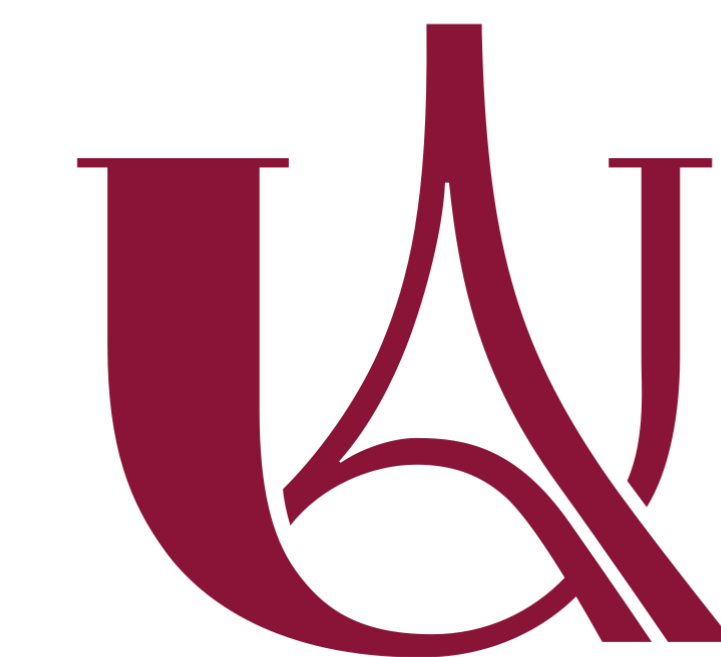


[EP06.14] Early hub organization and progressive strengthening of the structural connectome



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Background & Objective

Previous studies have shown that **structural connectivity increases during gestation**; however, little is known about whether this reflects **progressive network reorganization** or **strengthening of an already established architecture**. We aimed to distinguish between these two developmental patterns.

Methods

Type of study: prospective

Inclusion: healthy fetuses between 21 and 36 weeks

Fetal MRI: 1.5-T MRI system.

Diffusion Tensor Imaging (DTI) with 15 directions

Whole-brain structural connectomes were obtained using 30 atlas-defined regions of interest (ROIs).

Parameters studied:

- Global connectivity (streamline counts)
- Regional nodal strength (sum of streamline counts connecting a region to all other regions)
- Pairwise connections (streamline between regions)

Associations with gestational age (GA) were assessed using linear regression models.

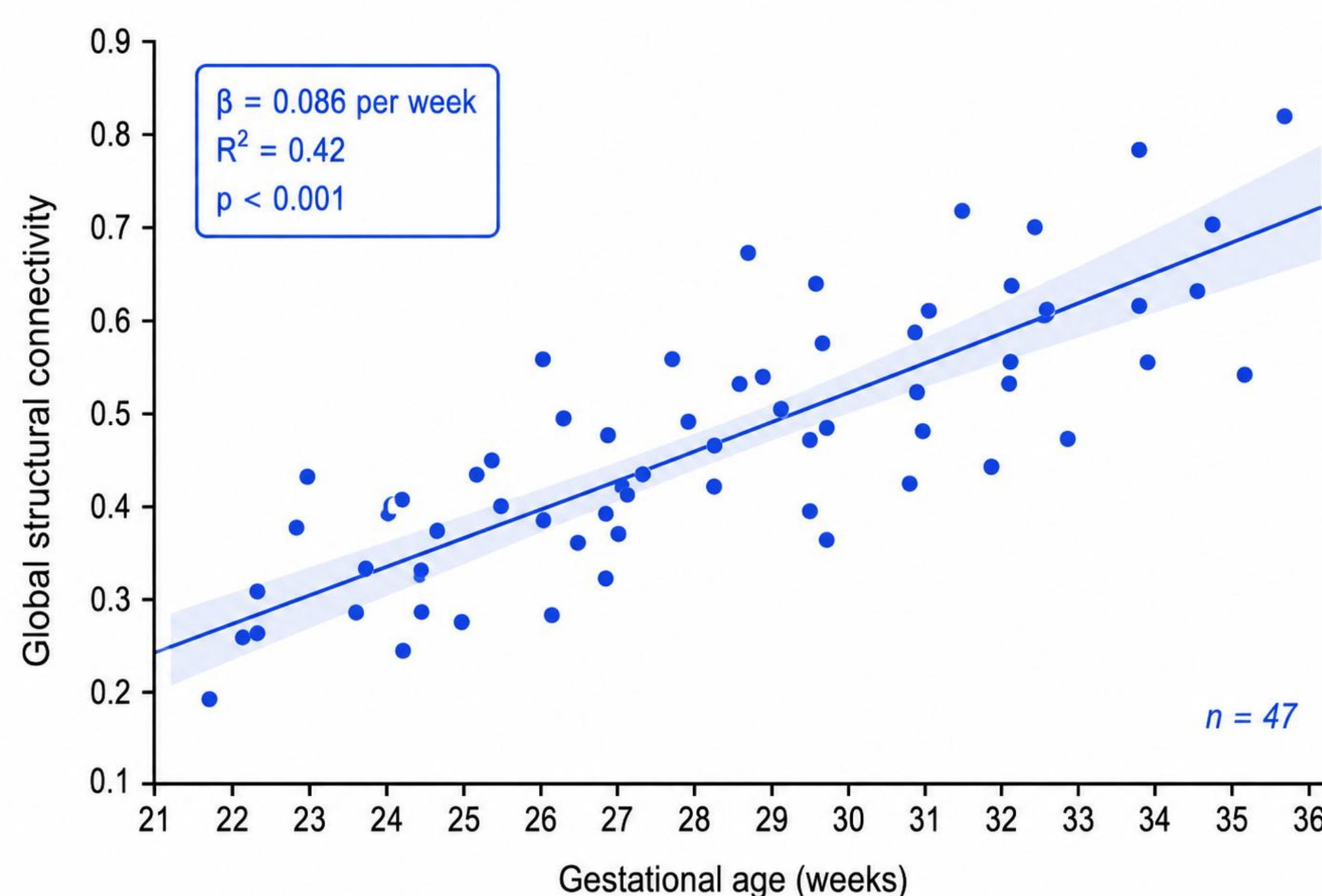
Hub regions = top 20% regions with the highest nodal strength.

Stability of regional connectivity across gestation was evaluated using Kendall rank correlation across three GA subgroup (<28, 28–31.9, ≥32 weeks).

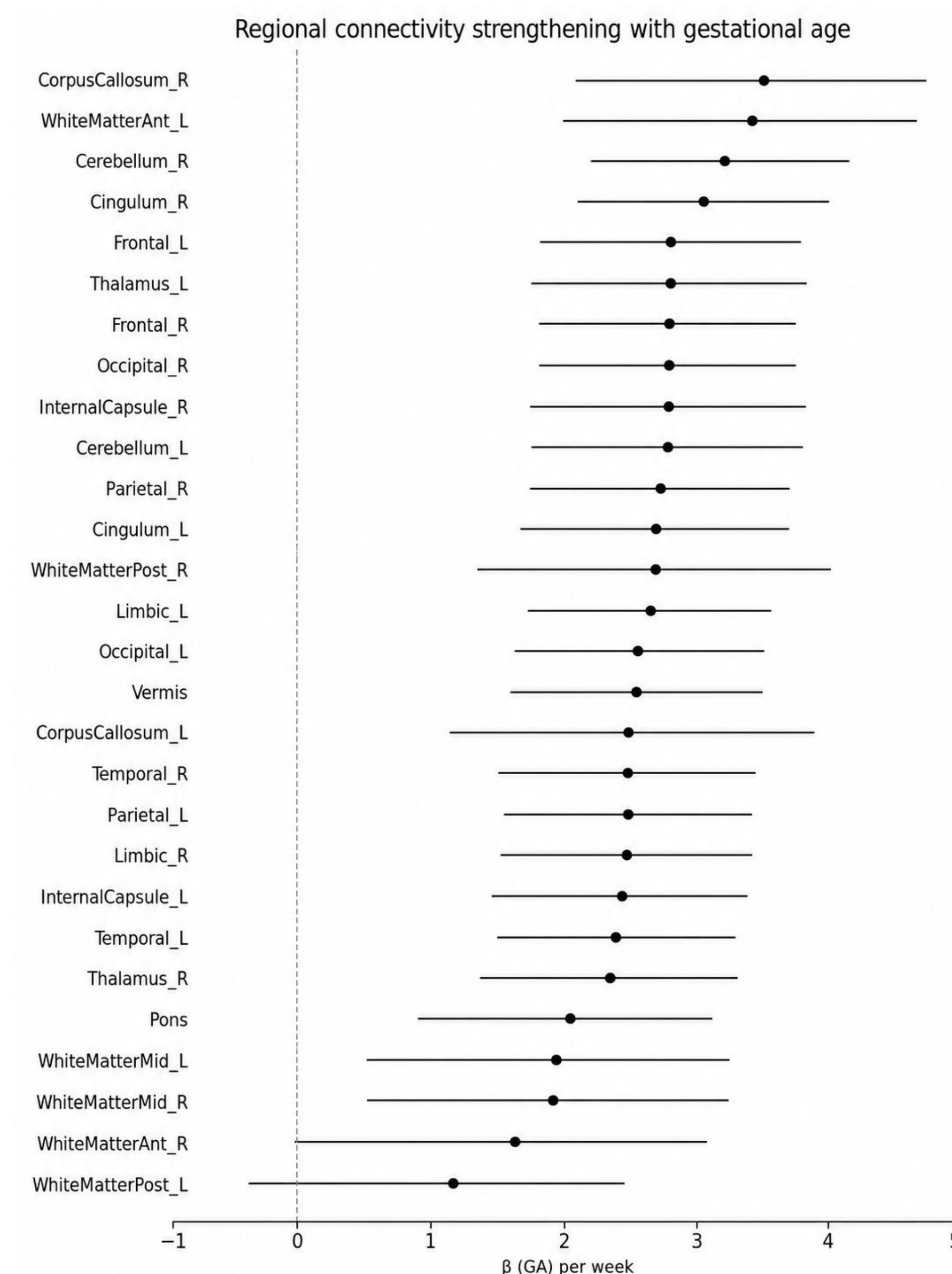
Results

Forty-seven fetuses were included: 15 <28 weeks, 16 between 28 and 32 weeks, and 16 > 32 weeks.

Global structural connectivity increased significantly with GA ($\beta = 0.086$ per week, $R^2 = 0.42$, $p < 0.001$).



At the regional level, 26 of 28 ROIs demonstrated significant connectivity strengthening with GA, with the strongest effects observed in cerebellar, frontal and cingulate regions (R^2 up to 0.51).



Regional connectivity hierarchy remained highly stable across gestation (Kendall $\tau = 0.831$ – 0.899 , all $p < 0.001$).

Conclusion

The fetal structural connectome strengthens during gestation while maintaining a stable regional hierarchy, suggesting that hub organization is established early and subsequently reinforced.