White Matter Changes from Infancy to Adulthood

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Introduction

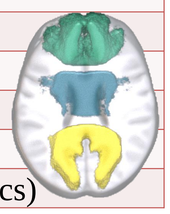
Diffusion MRI is well suited to track the development of white matter (WM) across the lifespan. Diffusion tensor imaging (DTI) provides in vivo indices of WM structure and tractography analyses can help to further investigate the major WM connections. In the current study, we used DTI to investigate **developmental trajectories of WM fractional anisotropy (FA) and mean diffusivity (MD)** in typically developing subjects across the lifespan. **Probabilistic tractography** algorithms were applied to reconstruct and analyze **16 major fiber bundles**.

Methods

- *N* = 10365 structural MRIs from our scanning acquisitions and open-access sources
  - *n* = 5506 females; *n* = 4859 males
  - 15 days - 100 years
- *N* = 5404 multi-shell diffusion MRIs
  - *n* = 2864 females; *n* = 2540 males
  - 30 days - 89 years

- susceptibility-induced distortions, Eddy current, and motion artifacts corrections on all volumes
- Diffusion tensor fitted a t each voxel to estimate FA and MD
- Probabilistic tractography to obtain 13 association and 3 commissural tracts

Association Tracts
Anterior thalamic radiation (atr)
Dorsal cingulum (cbd)
Perigenual cingulum (cbp)
Temporal cingulum (cbt)
Corticospinal tract (cst)
Fornix (fx)
Inferior longitudinal fasciculus (ifo)
Inferior fronto-occipital fasciculus (ilf)
Superior longitudinal fasciculus (slf 3 sub-sections)
Uncinate fasciculus (uf)
Optic radiation (or)
Commissural tracts
Genu of the corpus callosum (ccg)
Body of the corpus callosum (ccb)
Splenium of the corpus callosum (ccs)

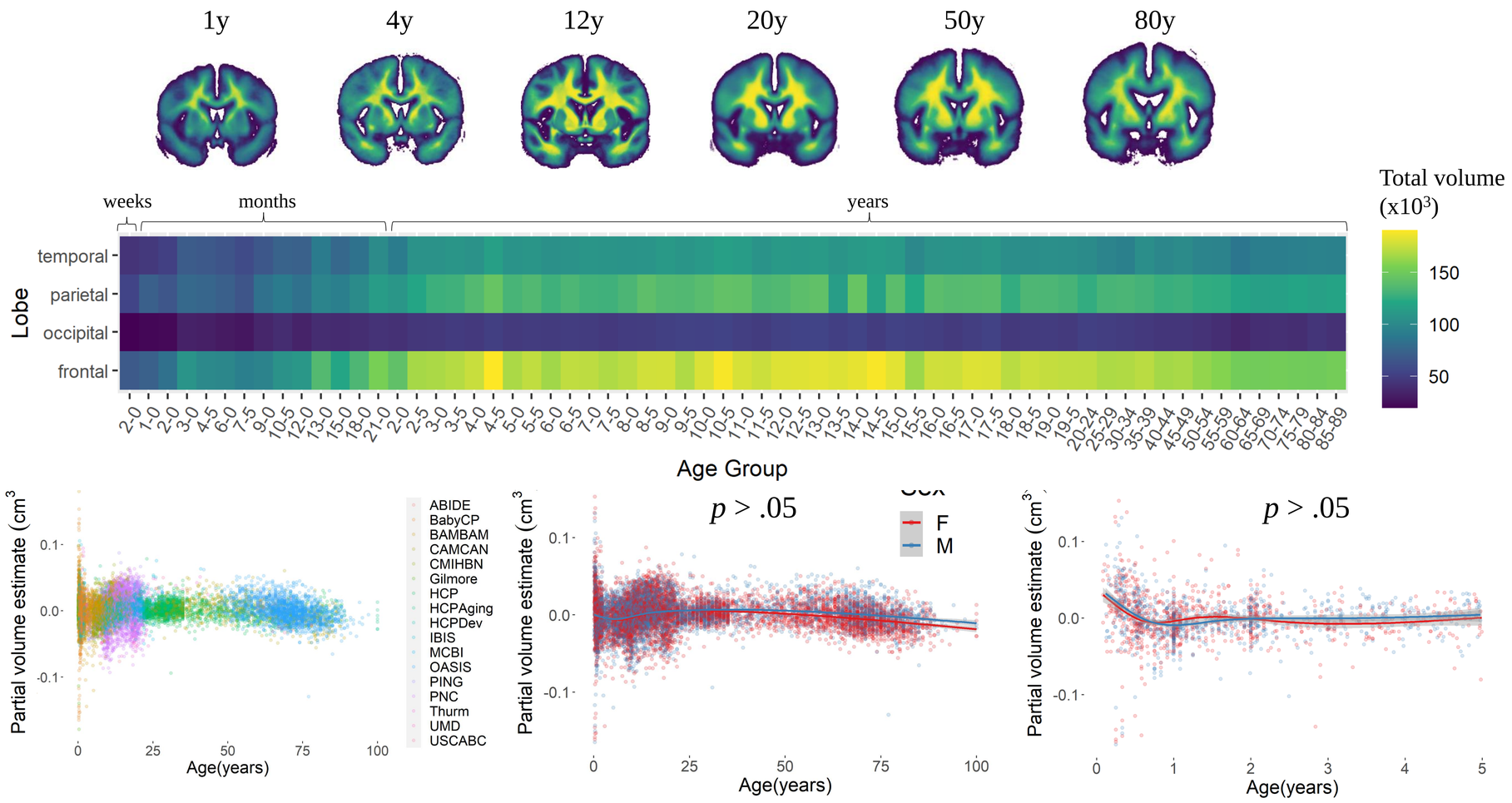


Analyses

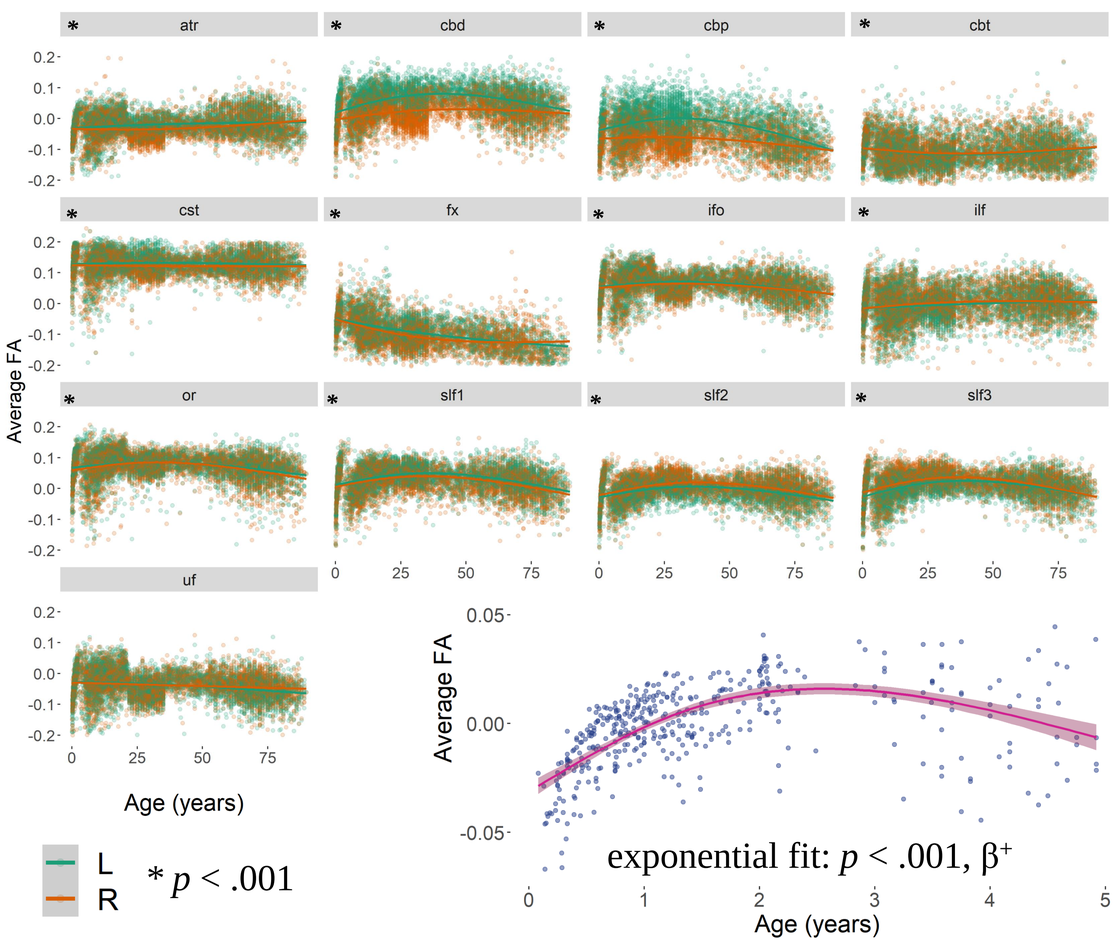
Linear mixed-effects models were performed to test the effect of age, biological sex, hemisphere (association tracts only), and their interaction, considering database as a random effect.)

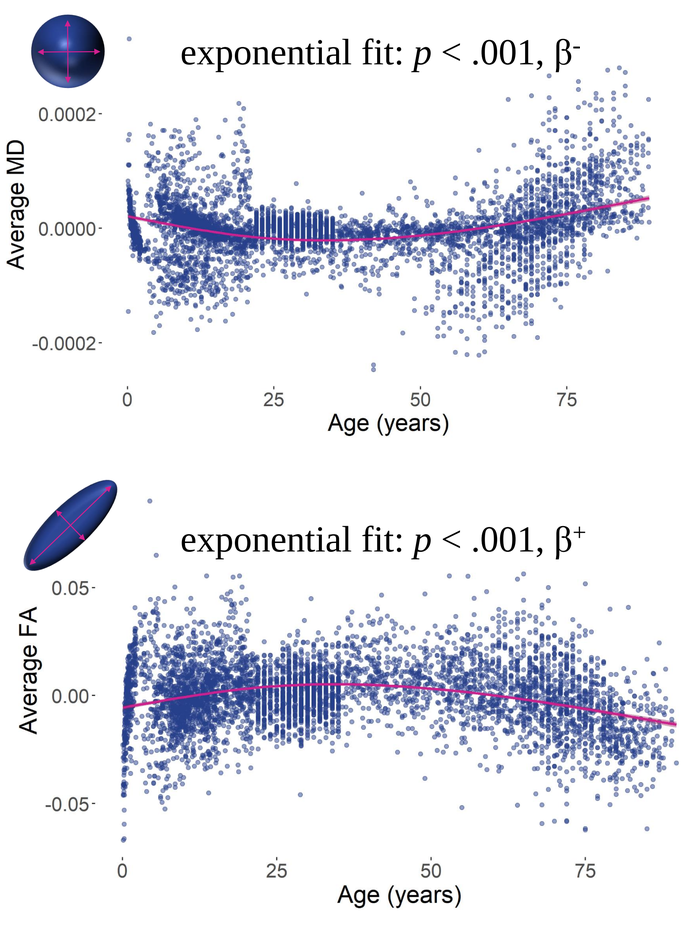
Null, linear, quadratic, cubic, and exponential models were fit for both MD and FA values across the brain and individual tracts.

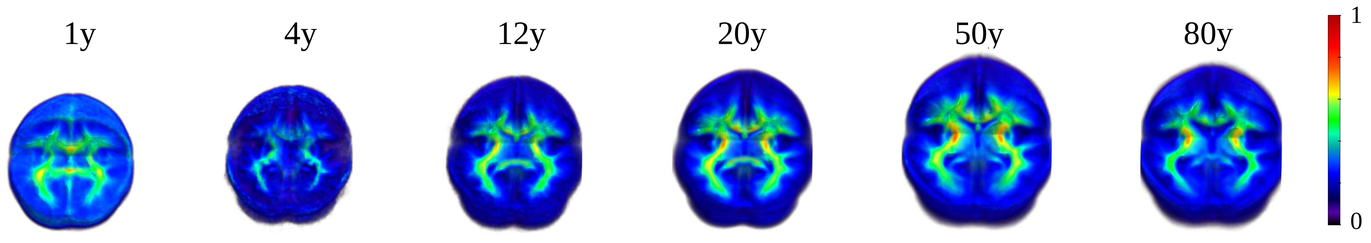
Macrostructural WM properties



Microstructural WM properties







- **Results suggest that an exponential trend best describes the changes in WM properties across the lifespan**
- **The developmental rate does not vary between female and male subjects**
- **Hemispherical differences occur for all tracts under investigation, except for the uncinate fasciculus**