

Advances in medical imaging enable visualization of white matter tracts in fetuses

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Researchers from the £12 million Developing Human Connectome Project have used the dramatic advances in medical imaging the project has provided to visualize and study white matter pathways, the wiring that connects developing brain networks, in the human brain as it develops in the womb.

Published today in *Proceedings of the National Academy of Sciences of The United States of America*, the study used [magnetic resonance images](#) (MRI) with unprecedented resolution from more than 120 healthy fetuses across the second and third trimesters of pregnancy to define how the structural connections in their brains first develop.

This is the largest and most detailed publicly available fetal MRI data set which will be released through the developing Human Connectome Project with other state-of-the-art fetal MR data including anatomical and functional images.

The diffusion data acquired were significantly richer than any previous data in this population, giving researchers much more sensitivity and specificity with respect to the location, shape and structure of the white matter tracts.

Sian Wilson, MRC-Sackler Ph.D. student in the School of Biomedical Engineering & Imaging Sciences at King's College London said the work is significant as it is increasingly recognized that many injuries that take place during the fetal period often affect white matter development.

From a clinical point of view, the results help to understand what the normal trajectories of white matter look like so they can be used as a reference for when problems arise.

Crucially, before these advanced MR methods were possible, this kind of insight could only be achieved through studying small numbers of post-mortem samples and very little was known about how maturation occurs in the healthy fetal brain.

The results demonstrate that different white matter tracts in the brain mature at different rates and have distinct development trajectories. This implies important differences in the timing of vulnerability for different

white matter tracts. Understanding this vulnerability has implications for the best time to try and treat diseases affecting the developing white matter such as those affecting preterm infants.

"Similar studies in the past included fetuses with brain injuries in their datasets, meaning characterisation of normal development was not possible" Ms Wilson said.

"In this cohort, our population did not have any abnormalities so it gives unique insight into how normal development takes place and over a timeframe in development when the most dramatic changes in the white matter structure are taking place."

Dr. Tomoki Arichi, MRC Clinician Scientist and Clinical Senior Lecturer in the Department of Perinatal Imaging & Health at the School of Biomedical Engineering & Imaging Sciences at King's College London, said the study and the fetal cohort is a huge advance in what is known about white matter [development](#) in the human brain.

"The study is the culmination of 5 years' work on the dHCP to build towards a point where we can get really robust diffusion MRI data from this incredibly challenging population, and so represents a landmark for providing in-vivo visualization of how white matter first develops in the human [brain](#)," he said.

"The applications of the findings are exciting because we can now compare these normal developmental trajectories to those from other large existing cohorts with abnormalities such as babies born preterm"

More information: Siân Wilson et al. Development of human white matter pathways in utero over the second and third trimester, *Proceedings of the National Academy of Sciences* (2021). [DOI: 10.1073/pnas.2023598118](https://doi.org/10.1073/pnas.2023598118)

Provided by King's College London

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