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An interactive meta-analysis of MRI biomarkers of myelin

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DOI:
10.21105/NeuroLibre.0XXXX

Software

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Editor: Pending Editor

Submitted: Unavailable
Published: 19 October 2021

Summary

In this work, we explore important aspect of quantitative magnetic resonance imaging (qMRI): validation (Cohen-Adad, 2018). Focusing specifically on myelin measures, we show the results of our meta-analysis comparing quantitative MRI with histology.

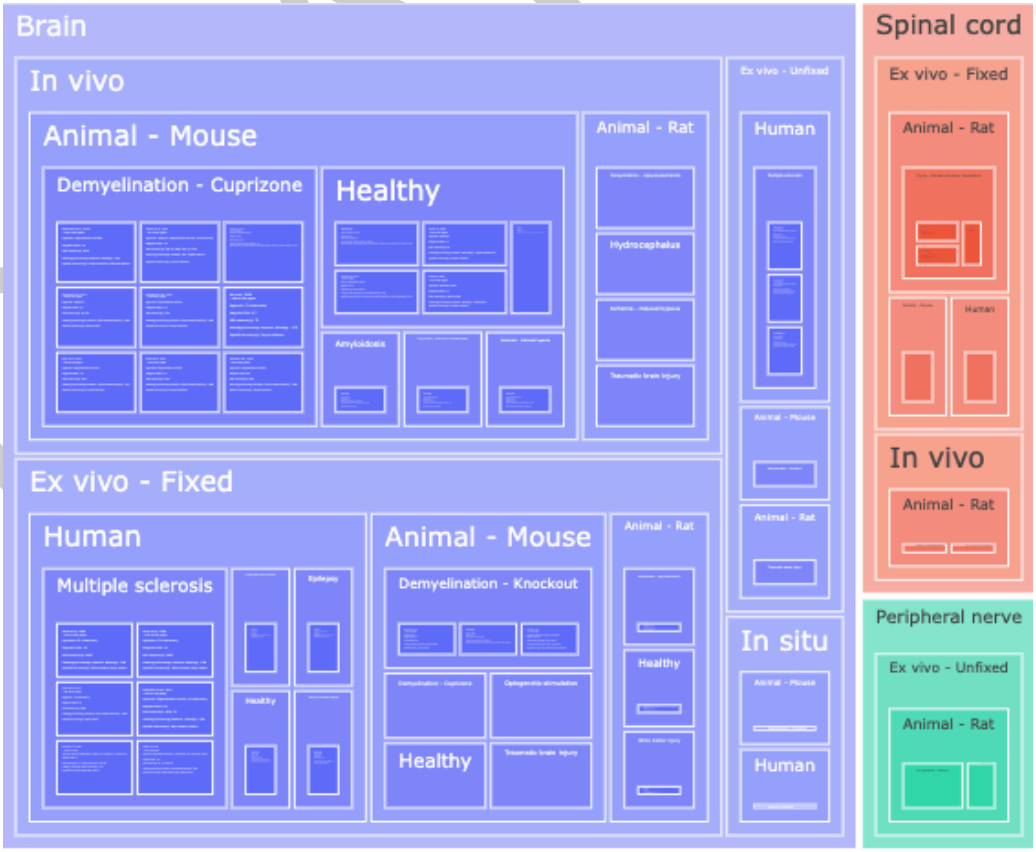

Figure 1: Treemap chart of the studies considered for the meta-analysis, organized by MRI measure. The color of each box represents the reported R2 value while the size box is proportional to the sample size.

Why myelin?: Myelin is a key component of the central nervous system. The myelin sheaths insulate axons with a triple effect: allowing fast electrical conduction, protecting the axon, and providing trophic support. The conduction velocity regulation has become an important research topic, with evidence of activity-dependent myelination as an additional mechanism of plasticity. Myelin is also relevant from a clinical perspective, given that demyelination is often observed in several neurological diseases such as multiple sclerosis.

How qMRI measures validated?: Similarly to other qMRI biomarkers, MRI-based myelin measurements are noisy, indirect, and might be affected by other microstructural features. Assessing the accuracy of such measurements, as well as their sensitivity to change, is essential for their translation into clinical practice. That is why histological validation is necessary. The most common validation approach is based on acquiring MR data from in vivo or ex vivo tissue and then comparing those data with the related samples analysed using histological techniques.

Why meta analysis?: So far, a long list of studies have looked at MRI-histology comparisons, each of them focusing on a specific pathology and a few MRI measures. Despite these numerous studies, there is still an ongoing debate on what MRI measure should be used to quantify myelin and as a consequence there is a constant methodological effort to propose new measures. We believe that this debate would benefit from a quantitative analysis of all the findings published so far, specifically addressing inter-study variations and prospects for future studies, something that is currently missing from the literature.

Acknowledgements

MM was funded by the Wellcome Trust through a Sir Henry Wellcome Postdoctoral Fellowship [213722/Z/18/Z]. TEN was supported by NIH grant R01MH096906.

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