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**Microstructural and metabolic alterations in the zebrafish brain induced by toll-like receptor 2 deficiency: insights from ultra-high field magnetic resonance imaging and spectroscopy**

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# **Microstructural and Metabolic Alterations in the Zebrafish Brain Induced by Toll-Like Receptor 2 Deficiency**

Insights from Ultra-High Field Magnetic  
Resonance Imaging and Spectroscopy

**Rico Singer**

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# **Microstructural and Metabolic Alterations in the Zebrafish Brain Induced by Toll-Like Receptor 2 Deficiency**

Insights from Ultra-High Field Magnetic  
Resonance Imaging and Spectroscopy

## **Proefschrift**

ter verkrijging van  
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# LIST OF ABBREVIATIONS

| ABBREVIATIONS   | DEFINITION                                   |
|-----------------|--|
| ADC             | Apparent diffusion coefficient               |
| ADHD            | Attention deficit hyperactivity disorder     |
| Ala             | Alanine                                      |
| Asp             | Aspartate                                    |
| Cans            | Ansulate commissure                          |
| CB              | Cerebellum                                   |
| CCeg            | Granular layer of the cerebellar corpus      |
| CCem            | Molecular layer of the cerebellar corpus     |
| Cgus            | Commissure of the secondary gustatory nuclei |
| Cho             | Choline                                      |
| Chol            | Cholesterol                                  |
| CNR             | Contrast-to-noise ratio                      |
| CNS             | Central nervous system                       |
| CPMG            | Carr-Purcell Meiboom-Gill                    |
| Cpost           | Posterior commissure                         |
| CSD             | Constraint spherical deconvolution           |
| CSF             | Cerebrospinal fluid                          |
| CT              | Computed tomography                          |
| Cven            | Ventral rhombencephalic commissure           |
| CW              | Continuous wave                              |
| $D_{\parallel}$ | Axial diffusivity                            |
| $D_{\perp}$     | Radial diffusivity                           |
| DALY            | Disability-adjusted life year                |
| DAMP            | Danger-associated molecular pattern          |
| DC              | Diencephalon                                 |
| DEC             | Directional encoded colour                   |
| DIL             | Diffuse nucleus of the inferior lobe         |
| DKI             | Diffusion kurtosis imaging                   |

|                 |  |
|-----------------|--|
| DM              | Medial zone of dorsal telencephalon            |
| dMRI            | Diffusion-based magnetic resonance imaging     |
| DTI             | Diffusion tensor imaging                       |
| DW              | Diffusion weighted                             |
| DWI             | Diffusion-weighted imaging                     |
| EPI             | Echo-planar imaging                            |
| ETL             | Echo train length                              |
| FA              | Fractional anisotropy                          |
| FID             | Free-induction decay                           |
| fODF            | Fibre orientation distribution functions       |
| FOV             | Field of view                                  |
| GABA            | $\gamma$ -aminobutyric acid                    |
| $G_{diff}$      | Diffusion gradient                             |
| $G_f$           | Frequency encoding gradient                    |
| Gln             | Glutamine                                      |
| Glu             | Glutamate                                      |
| GM              | Grey matter                                    |
| $G_p$           | Phase encoding gradient                        |
| $G_s$           | Slice encoding gradient                        |
| HR-MAS          | High-resolution magic angle spinning           |
| ISIS            | Image selected <i>in vivo</i> spectroscopy     |
| $K_{\parallel}$ | Axial kurtosis                                 |
| $K_{\perp}$     | Radial kurtosis                                |
| KFA             | Kurtosis Fractional anisotropy                 |
| KO              | Knock-out                                      |
| Lac             | Lactate  |
| LASER           | Localization by adiabatic selective refocusing |
| LLF             | Lateral longitudinal fascicle                  |
| MC              | Mesencephalon                                  |
| MD              | Mean diffusivity                               |
| m-Ins           | Myo-inositol                                   |
| MK              | Mean kurtosis                                  |
| MLF             | Medial longitudinal fascicle                   |

|       |   |
|-------|---|
| MRI   | Magnetic resonance imaging                    |
| MRS   | Magnetic resonance spectroscopy               |
| MSME  | Multi-slice multi-echo                        |
| msmt  | Multi-shell multi-tissue                      |
| NAA   | N-acetylaspartate                             |
| NAAG  | N-acetylaspartyl-glutamate                    |
| NMR   | Nuclear magnetic resonance                    |
| OB    | Olfactory bulb                                |
| OT    | Optic tract                                   |
| OVS   | Outer volume suppression                      |
| PA    | Pallium                                       |
| PAMP  | Pathogen-associated molecular pattern         |
| pCho  | Phosphocholine                                |
| PRESS | Point resolved spectroscopy                   |
| PRR   | Pattern recognition receptors                 |
| RARE  | Rapid acquisition with relaxation enhancement |
| RC    | Rhombencephalon                               |
| RF    | Radio frequency                               |
| ROI   | Region of interest                            |
| SNR   | Signal-to-noise ratio                         |
| STEAM | Stimulated echo acquisition mode              |
| stTDI | Short-track track-density imaging             |
| T     | Tesla   |
| $T_1$ | Longitudinal relaxation time                  |
| $T_2$ | Transverse relaxation time                    |
| Tau   | Taurine                                       |
| $tBW$ | Transmission bandwidth                        |
| tCr   | Total creatine                                |
| TE    | Echo time                                     |
| TeO   | Optic tectum                                  |
| TL    | Longitudinal torus                            |
| TLR   | Toll-like receptor                            |
| TR    | Repetition time                               |

|     |                             |
|-----|-----------------------------|
| UHF | Ultra-high field            |
| WM  | White matter                |
| WS  | Water suppression           |
| YLD | Years lived with disability |