

**ZoomCOVID: Zooming in on cerebral abnormalities in severely affected COVID-19 patients: a 3T and 7T MRI study**

N. van der Knaap<sup>1,2,3</sup>, M.J.H. Ariës<sup>1,2</sup>, J.F.A. Jansen<sup>1,3</sup> on behalf of the ZoomCOVID study group

<sup>1</sup>School of Mental Health and Neuroscience, Maastricht University, Maastricht, The Netherlands

<sup>2</sup>Department of Intensive Care, Maastricht University Medical Center, Maastricht, The Netherlands

<sup>3</sup>Department of Radiology & Nuclear Medicine, Maastricht University Medical Center, Maastricht, The Netherlands

**BACKGROUND:** Coronavirus disease 2019 (COVID-19) primarily leads to pneumonia, resulting in severe inflammation and hypoxia. The virus also affects other organs and in COVID-19 intensive care unit (ICU) patients, brain injury is one of the complications. Although the precise underlying mechanism is unclear, it is likely caused by a combination of prolonged hypoxia, a massive systemic inflammatory response, direct infection of the brain and small vessel vasculitis in combination with widespread hypercoagulopathy and thrombosis. Novel advanced MRI techniques can be used to non-invasively gain insight in the ways the COVID-19 virus affects the brain.

**AIM:** This project aims contribute to the current understanding of the COVID-19 neuropathogenesis in severely affected ICU survivors. The primary objective is to assess the relationship between disease severity, hypercoagulability, and inflammation during ICU admission with advanced quantitative 3T and 7T MRI metrics of (micro)vascular pathology, including BBB permeability, glymphatic dysfunction and neurovascular unit impairment. A secondary objective is to study the (micro)structural and/or (micro)vascular alterations in the olfactory tract and brain stem and assess a possible relationship to prodromal symptoms and residual complaints.

**STUDY POPULATION:** A total number of 70 adults who survived a severe (ICU admission required) COVID-19 infection during the second/third COVID wave. These patients will be recruited from the MaastrICCh cohort from the Department of Intensive Care (MUMC+).

**METHODS:** Participants will visit the MUMC+ hospital 12-24 months after ICU admission for blood tests, global neuropsychological assessment (including smell and taste), functional status assessment, and a 3T MRI scan. The MRI protocol includes scans to study structural cerebral abnormalities, microvasculature, blood-brain barrier permeability, and perfusion measurements using dynamic imaging with intravenous contrast. A subset of the included participants will additionally be scanned using the 7T MRI scanner at the Scannexus scanning facility to obtain higher resolution brain images and assess the glymphatic system, and integrity of the brain stem and olfactory tract. The main study endpoints include radiological, clinical, and neuropsychological outcome at 12-24 months follow-up.

*Keywords: COVID-19, ICU, MRI*