Faculty of Medicine
Diffusion Tensor Imaging and other quantitative structural neuroimaging after COVID-19 infection: A systematic review

Background
• Neuropathologies are commonly reported in COVID-19 patients.1
• Most COVID-19 neuroimaging reviews have focused on qualitative findings such as infarcts and microbleeds.
• The few quantitative neuroimaging reviews do not distinguish between acute and chronic periods after COVID-19.2

Aim
Systematically evaluate the volumetric and diffusion MRI (dMRI) differences between COVID-19 patients and non-COVID-19 controls in patients unselected for COVID-19 symptoms in the chronic period after infection.

Methods
• Screening, extraction, and risk of bias assessments performed by 2 independent reviewers and conflicts were resolved by a 3rd reviewer.
• Inclusion Criteria:
  o Comparison of brain volumes or dMRI metrics between COVID-19 and controls.
  o MRI acquired more than 6-weeks after COVID-19.
  o >5 participants in each group.
• Exclusion Criteria:
  o Selected COVID-19 patients based on the presence of specific COVID-19 symptoms (e.g., loss of smell)
  o Case reports, post-mortem studies, pre-prints, and conference proceedings.
  o NIH NHLBI Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies.

Results
• 18 studies included, 9 reported diffusion imaging, 12 reported brain volumes (Figure 1).
• Most studies included only hospitalized COVID-19 patients (n=10).
• Follow-up time ranged from 2-months to 2-years.

Overall findings
• 5 studies reported lower anisotropy, 1 reported higher anisotropy, and 3 reported both higher and lower anisotropy in different regions in COVID-19 compared to controls.
• 6 studies reported smaller brain volumes, 2 reported larger brain volumes, and 4 reported no differences between COVID-19 patients and controls.
• Hospitalization and ICU admittance had lower anisotropy and smaller brain volumes compared to milder illness.

Diffusion Imaging Results
• Common regions with differences in anisotropy (Figure 2):
  COVID-19 < Controls: superior longitudinal fasciculus, corpus callosum, corona radiata, posterior thalamic radiation, superior fronto-occipital fasciculus, cingulum.
  COVID-19 > Controls: cerebellum, corona radiata, sagittal stratum, internal capsule.

Volume Results
• Common regions with differences in brain volumes between COVID-19 and controls (Figure 3):
  COVID-19 < Controls: grey matter volume, hippocampus, thalamus, putamen, cerebellum.
  COVID-19 > Controls: grey matter volume, hippocampus, amygdala.

Conclusions
• Most studies report smaller grey matter volumes or lower anisotropy in COVID-19 patients compared to controls.
• Heterogeneity of results may relate to the severity of COVID-19 illness and time between COVID-19 and MRI.
• Future studies should consider the effect of vaccination and potential differential effects of different SARS-CoV-2 variants.

References

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