Olfactory Function and Brain Structural Effects Following SARS-CoV-2 Infection

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716

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BACKGROUND

SARS-CoV-2 infection is accompanied by acute olfactory disturbance in up to 70% of cases. This loss is associated with decreased olfactory bulb volume. As time passes, the anosmia tends to subside, but the OB volume decrease may not. Volume reductions in primary and secondary olfactory cortex are also seen following SARS-CoV-2 infection. Nevertheless, concurrent SARS-CoV-2 infection effects on olfactory discrimination, olfactory bulb volume, primary olfactory cortex and its targets have not been investigated. We measured olfactory discrimination, olfactory bulb volume, primary olfactory cortex and basal ganglia volume in patients who had SARS-CoV-2 infection more than 12 weeks previously. Participants were then divided into COVID and Long-COVID groups on the basis of self-reported fatigue and concentration complaints.

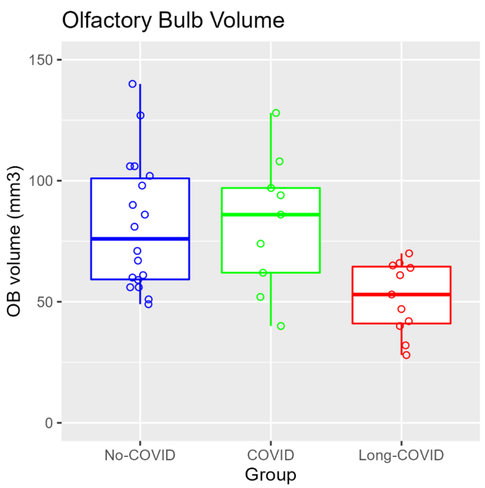
METHODS

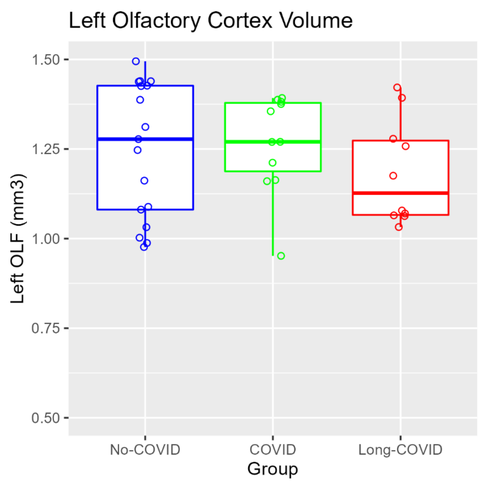
This cross-sectional study included 25 post-infection and 19 demographically-matched, No-COVID control participants. We investigated effects on olfaction using NIH Toolbox Odor Identification Test and the Monell Smell Questionnaire. Gray matter (GM) structure was assessed with voxel-based morphometry and manual delineation of high resolution (1mm^3), T1- and T2-weighted MRI data. Linear regression was used to model group effects on GM structure, adjusting for age, sex, education and total intracranial volume. CAT12/SPM12 and R were used for image processing and statistical modeling.

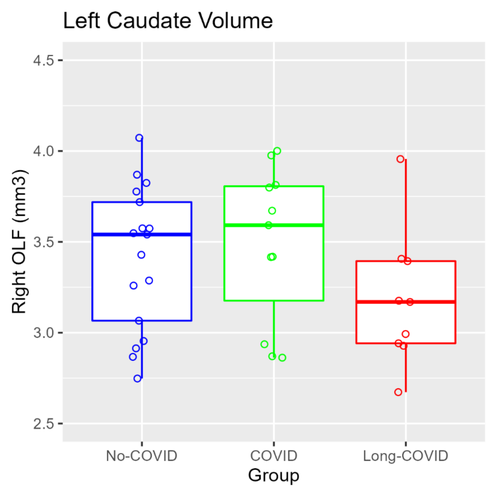
Chronic effects of SARS-CoV-2 infection can extend beyond the olfactory periphery to affect central targets including olfactory cortex and the basal ganglia.

RESULTS

The NIH Toolbox Odor Identification Test failed to show differences among the groups. In contrast, the Monell Smell Questionnaire revealed persistently diminished and distorted smell in 50% of the Long-COVID sample. Olfactory bulb volume was lower in the long-COVID group (p=0.02). Primary olfactory cortex volume was reduced in the long-COVID group (p=0.004). Caudate volume was also lower in the Long-COVID group (p=0.04).







CONCLUSIONS

In the absence of olfactory discrimination problems, Long-COVID, but not COVID, participants experienced persistent olfactory loss and distortion. These perceptual problems were associated with lower olfactory bulb, primary olfactory cortex and caudate volume, suggesting that the effects of SARS-CoV-2 infection can extend beyond the olfactory periphery in some cases to affect central targets, possibly contributing to persistent distortion of smell.

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Primary olfactory cortex and caudate volumes are lower (yellow) in long-COVID.

