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# Neurological manifestations in COVID-19: a systematic review and meta-analysis

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## Abstract

**Objective:** Following the outbreak of coronavirus 2019 (COVID-19), there is strong evidence of neurological involvement in these patients. We aimed to determine the clinical characteristics of neurological manifestations in COVID-19.

**Method:** A systematic review of studies reporting neurological manifestations published between 1 December, 2019 and 11 May, 2020 was performed. Studies were grouped based on neurological manifestation. Pooled analyses of individual patient's clinical characteristics and olfactory and gustatory dysfunction prevalence were performed.

**Results:** Of 486 studies identified, 48 were included. 70 patients with 73 neurological manifestations were reported. 39 (53.4%) patients had stroke, 18 (24.7%) had Guillain-Barré syndrome and variants, 11 (15.1%) had meningitis, encephalitis, encephalopathy, or myelitis, and five (6.8%) had seizures. They had a mean age of  $61.9 \pm 17.7$  years (60.6% male). Neurological disease occurred  $8.1 \pm 6.8$  days from initial symptoms. Average mortality rate was 17.8%. Stroke has a mortality rate of 25.6%. Olfactory and gustatory dysfunction occurred in 59.9% and 57.5%, respectively.

**Conclusions:** Stroke is the most frequently reported neurological manifestation in COVID-19 and has the highest mortality rate. Neurological manifestations tend to develop one to two weeks after the onset of respiratory disease. There is significant morbidity and mortality associated with COVID-19 neurological manifestations.

**Keywords:** COVID-19; Guillain-Barré syndrome; cerebrovascular; encephalitis; neurological.

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