

# Coronavirus Disease 2019 (COVID-19)



## Late Sequelae of COVID-19

Updated Nov. 13, 2020 [Print](#)

The identification of the novel coronavirus SARS-CoV-2 in December 2019 has led to a growing and continually evolving body of knowledge about the virus and the disease it causes, COVID-19.

In peer-reviewed literature and public discussion, persistent symptoms are being reported among COVID-19 survivors, including individuals who initially experience a mild acute illness. These persistent symptoms pose new challenges to patients, healthcare providers, and public health practitioners. The natural history of SARS-CoV-2 infection and COVID-19 is a current area of investigation, and the prevalence, type, duration, and severity of persistent symptoms following resolution of acute SARS-CoV-2 infection, as well as risk factors associated with their development, are currently being studied.

While older patients may have an increased risk for severe disease, young survivors, including those physically-fit prior to SARS-CoV-2 infection, have also reported symptoms months after acute illness<sup>(1,2,11)</sup>. Research is underway to differentiate symptoms of a prolonged course of COVID-19 illness from sequelae following resolution of acute SARS-CoV-2 infection, achieve consensus on the time period at which to define the post-acute and long-term phases of COVID-19, and distinguish health effects exclusively related to infection with SARS-CoV-2 from consequences of procedures and treatments required for care of persons with severe disease of any etiology.

Characterization of the etiology and pathophysiology of late sequelae is underway, and may reflect organ damage from the acute infection phase<sup>(17)</sup>, manifestations of a persistent hyperinflammatory state<sup>(27,31)</sup>, ongoing viral activity associated with a host viral reservoir<sup>(14)</sup>, or an inadequate antibody response<sup>(30)</sup>. Factors in addition to acute disease that may further complicate the picture include physical deconditioning<sup>(10)</sup> at baseline or after a long disease course<sup>(29)</sup>, pre-COVID-19 comorbidities<sup>(18)</sup>, and psychological sequelae following a long or difficult disease course<sup>(31)</sup> as well as those relating to lifestyle changes due to the pandemic<sup>(9)</sup>. Likely, the persistent sequelae of COVID-19 represent multiple syndromes resulting from distinct pathophysiological processes along the spectrum of disease.

Though there is limited information on late sequelae of COVID-19, reports of persistent symptoms in persons who recovered from acute COVID-19 illness have emerged<sup>(5,6,7,12,13,28)</sup>. The most commonly reported symptoms include fatigue, dyspnea, cough, arthralgia, and chest pain<sup>(1,3,5,13,16,18,28)</sup>. Other reported symptoms include cognitive impairment,

depression, myalgia, headache, fever, and palpitations (1, 3, 5, 13, 16, 18, 28). More serious complications appear to be less common but have been reported. These complications include:

- Cardiovascular: myocardial inflammation, ventricular dysfunction (23-25)
- Respiratory: pulmonary function abnormalities (15, 32)
- Renal: acute kidney injury (22)
- Dermatologic: rash, alopecia (16)
- Neurological: olfactory and gustatory dysfunction, sleep dysregulation, altered cognition, memory impairment (1, 3, 13, 16, 19, 20)
- Psychiatric: depression, anxiety, changes in mood (3, 13, 16)

Post-COVID-19 care centers are opening at academic medical centers in the United States, bringing together multidisciplinary teams to provide a comprehensive and coordinated treatment approach to COVID-19 aftercare. The National Institutes of Health have published [interim guidelines for the medical management of COVID-19](#) [↗](#), including a section on persistent symptoms or illnesses after recovery from acute COVID-19. These guidelines will be updated as new information emerges. Survivor support groups are connecting individuals, providing support, and sharing resources with survivors and others affected by COVID-19 (4, 26). Multi-year studies will be crucial in elucidating longer-term sequelae. CDC continues active investigation into the full spectrum of COVID-19 to establish a more complete understanding of the natural history of SARS-CoV-2 infection and COVID-19 related illnesses, which can inform care strategies as well as the public health response to this virus.

## Ongoing research

- National Institutes of Health, National Institute of Allergy and Infectious Diseases. A longitudinal study of COVID-19 sequelae and immunity. <https://clinicaltrials.gov/ct2/show/NCT04411147> [↗](#)
- University of California, San Francisco. Long-term impact of infection with novel coronavirus (COVID-19) (LIINC). <https://clinicaltrials.gov/ct2/show/record/NCT04362150> [↗](#)

## References

1. Assaf G, Davis H, McCorkell L, et al. What does COVID-19 recovery actually look like? An analysis of the prolonged COVID-19 symptoms survey by Patient-Led Research Team. Patient Led Research for COVID-19, 2020. <https://patientresearchcovid19.com/> [↗](#) .
2. Asthma UK and British Lung Foundation. Get support after COVID-19. Post-COVID HUB. 2020. <https://www.post-covid.org.uk/get-support/> [↗](#)
3. Banda JM, Singh GV, Alser O, et al. Long-term patient-reported symptoms of COVID-19: an analysis of social media data. *medRxiv*. 2020. <https://doi.org/10.1101/2020.07.29.20164418> [↗](#)
4. Body Politic. COVID-19 Support Group. 2020. <https://www.wearebodypolitic.com/covid19> [↗](#)

5. Carfi A, Bernabei R, Landi F, et al. Persistent symptoms in patients after acute COVID-19. *JAMA*. 2020;324(6):603-605.
6. COVID Symptom Study. How long does COVID-19 last? Kings College London, 2020. [https://covid19.joinzoe.com/post/covid-long-term?fbclid=IwAR1RxlcmmdL-EFjh\\_al-](https://covid19.joinzoe.com/post/covid-long-term?fbclid=IwAR1RxlcmmdL-EFjh_al-) .
7. del Rio C, Collins LF, Malani P. Long-term health consequences of COVID-19. *JAMA*. 2020. doi:10.1001/jama.2020.19719
8. Fraser E. Long term respiratory complications of covid-19. *BMJ*. 2020;370:m3001. doi:10.1136/bmj.m3001
9. Galea S, Merchant RM, Lurie N. The mental health consequences of COVID-19 and physical distancing: The need for prevention and early intervention. *JAMA Intern Med*. 2020;180(6):817–818. doi:10.1001/jamainternmed.2020.1562
10. Gemelli Against COVID-19 Post-Acute Care Study Group. Post-COVID-19 global health strategies: the need for an interdisciplinary approach. *Aging Clin Exp Res*. 2020. doi:10.1007/s40520-020-01616-x.
11. Godlee F. Living with covid-19. *BMJ* 2020;370:m3392. doi: <https://doi.org/10.1136/bmj.m3392>
12. Greenhalgh T, Knight M, A'Court C, et al. Management of post-acute covid-19 in primary care. *BMJ*. 2020;370:m3026.
13. Halpin, SJ, Mclvor, C, Whyatt, G, et al. Postdischarge symptoms and rehabilitation needs in survivors of COVID-19 infection: A cross-sectional evaluation. *J Med Virol*. 2020; 1– 10. <https://doi.org/10.1002/jmv.26368>
14. Hartley C, Bavinger JC, Kuthyar S, et al. Pathogenesis of uveitis in Ebola Virus Disease survivors: Evolving understanding from outbreaks to animal models. *Microorganisms*. 2020;8(4):594. doi:10.3390/microorganisms8040594
15. Huang Y, Tan C, Wu J, et al. Impact of coronavirus disease 2019 on pulmonary function in early convalescence phase. *Respir Res*. 2020;21(1):163. doi:10.1186/s12931-020-01429-6
16. Lambert NJ and Survivor Corps. COVID-19 “Long Hauler” Symptoms Survey Report. Indiana University School of Medicine; 2020. <https://dig.abclocal.go.com/wls/documents/2020/072720-wls-covid-symptom-study-doc.pdf>
17. Ngai JC, Ko FW, Ng SS, et al. The long-term impact of severe acute respiratory syndrome on pulmonary function, exercise capacity and health status. *Respirology*. 2010 Apr;15(3):543-50. doi: 10.1111/j.1440-1843.2010.01720.x
18. O'Keefe JB, Cellai M. Characterization of prolonged COVID-19 symptoms and patient comorbidities in an outpatient telemedicine cohort. *medRxiv*. 2020. doi:10.1101/2020.07.05.20146886.
19. Otte MS, Klussmann JP, Luers JC. Persisting olfactory dysfunction in patients after recovering from COVID-19. *J Infect*. 2020 Jun 24 [Epub ahead of print].
20. Paderno A, Mattavelli D, Rampinelli V, et al. Olfactory and gustatory outcomes in COVID-19: a prospective evaluation in nonhospitalized subjects. *Otolaryngol Head Neck Surg*. 2020 Jun 30 [Epub ahead of print].
21. Peleg Y, Kudose S, D'Agati V, et al. Acute kidney injury due to collapsing glomerulopathy following COVID-19 infection. *Kidney Int Rep*. 2020;5:940–945

23. Puntmann VO, Carerj ML, Wieters I, et al. Outcomes of cardiovascular magnetic resonance imaging in patients recently recovered from coronavirus disease 2019 (covid-19). *JAMA Cardiol.* 2020. doi:10.1001/jamacardio.2020.3557.
24. Rajpal S, Tong MS, Borchers J, et al. Cardiovascular magnetic resonance findings in competitive athletes recovering from COVID-19 infection. *JAMA Cardiol.* 2020. doi:10.1001/jamacardio.2020.4916 [↗](#)
25. Sardari A, Tabarsi P, Borhany H, et al. Myocarditis detected after COVID-19 recovery, *European Heart Journal – Cardiovascular Imaging.* 2020. <https://doi.org/10.1093/ehjci/jeaa166> [↗](#)
26. Survivor Corps. Survivor Corps. 2020. <https://www.survivorcorps.com/> [↗](#)
27. Tay MZ, Poh CM, Rénia L, et al. The trinity of COVID-19: immunity, inflammation, and intervention. *Nature Rev Microbiol.* 2020;20:363-374.
28. Tenforde MW, Kim SS, Lindsell CJ, et al. Symptom duration and risk factors for delayed return to usual health among outpatients with COVID-19 in a multistate health care systems network—United States, March-June 2020. *MMWR Morb Mortal Wkly Rep.* 2020;69:993-998.
29. Thornton J. Covid-19: the challenge of patient rehabilitation after intensive care. *BMJ.* 2020;369:m1787.
30. Wu F, Wang A, Liu M, et al. Neutralizing antibody responses to SARS-CoV-2 in a COVID-19 recovered patient cohort and their implications. 2020. <https://www.medrxiv.org/content/medrxiv/early/2020/04/06/2020.03.30.20047365.full.pdf>
31. Yende S, Kellum JA, Talisa VB, et al. Long-term host immune response trajectories among hospitalized patients with sepsis. *JAMA Netw Open.* 2019 Aug 2;2(8):e198686. doi: 10.1001/jamanetworkopen.2019.8686
32. Zhao YM, Shang YM, Song WB, et al. Follow-up study of the pulmonary function and related physiological characteristics of COVID-19 survivors three months after recovery. *EClinicalMedicine.* 2020;25:100463. doi:10.1016/j.eclinm.2020.100463 [↗](#)

Last Updated Nov. 13, 2020

Content source: [National Center for Immunization and Respiratory Diseases \(NCIRD\), Division of Viral Diseases](#)