Update: Epidemiologic Characteristics of Long COVID

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A general framework for Post-COVID Conditions

Wide range of physical and mental health consequences continue or develop at least 4 weeks after initial COVID-19 or SARS-CoV-2 infection

Post acute sequelae of SARS-CoV-2 infection

- System specific pathology (e.g. lung fibrosis, stroke)
- Clinically significant symptoms with unclear pathology (e.g. ME/CFS*-like, dysautonomia)
- On-going symptoms following MIS-C**

General consequences of illness and hospitalization

- Post ICU syndrome
- Other complications of treatment or illness

Conditions frequently overlap
Patients may experience any combination

Long COVID commonly used term for Post-COVID Conditions

*ME/CFS: Myalgic Encephalomyelitis/Chronic Fatigue Syndrome
**MIS-C: Multisystem Inflammatory Syndrome in Children
Estimating the Occurrence of Post-COVID Conditions
Prevalence of on-going symptoms lasting at least 3 months after COVID-19 by age, regardless of COVID status: U.S.

Nationally representative of non-institutional population in the U.S., statistical software was used to account for NHIS’s complex sampling design.

UNPUBLISHED CDC DATA – Preliminary estimates from 2022 National Health Interview Survey
The prevalence of Long COVID (currently reporting symptoms lasting ≥ 3 months) among non-institutionalized adults:

- Decreased from June 2022 to January 2023
- Remained unchanged through June 2023

Almost 1 in 4 adults with Long COVID report significant activity limitations.
SARS-CoV-2 infection associated with diagnosis of incident conditions

Using electronic health records and comparing patients with COVID-19 to those without evidence of COVID-19:

- **Among children and adolescents, increased risk of four symptoms and eight conditions** 31–365 days following COVID-19 ¹,²
  - Associated with an increased risk of heart conditions, kidney failure, blood clots, diabetes, fatigue, smell and taste disorders, neurological conditions

- **Among adults, 1 in 5 COVID-19 survivors** may have a health condition associated with previous COVID-19 in the 31 – 365 days following COVID-19 ³
  - Associated with an increased risk of cardiovascular events, kidney disease, respiratory conditions, diabetes, and neurological conditions ²,⁴,⁵,⁶

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2) Hernandez-Romieu AC et al. JAMA Netw Open. 2022; 5(2)
4) Post–acute sequelae of COVID-19 and cardiac outcomes in U. S. military members - ScienceDirect
5) Risk of persistent and new clinical sequelae among adults aged 65 years and older during the post-acute phase of SARS-CoV-2 infection: retrospective cohort study | The BMJ
6) Long-term neurologic outcomes of COVID-19 | Nature Medicine
Post-COVID Conditions symptoms and duration

In a prospective study of adults testing positive and negative for COVID-19:

• Following acute-COVID-like illness among adults, on-going symptoms decrease after 3 months, but 16% continue to experience on-going symptoms at 12 months

• Many adults reported new emerging or re-emerging symptoms at 6, 9, and 12 months following acute COVID-like illness

• Symptoms were not unique to SARS-CoV-2 infection

In the Veterans Affairs patient population:

• Post-COVID Conditions decreased 90 days after acute COVID-19, with increased risk of new conditions continuing for up to 2 years.

Postacute sequelae of COVID-19 at 2 years | Nature Medicine
Groups associated with a higher likelihood of developing Long COVID

- Female sex
- Older age (sometimes)
  - Adolescents compared to younger children
  - Middle-aged adults compared to younger and older adults for symptoms
  - Older adults compared to younger adults for incident conditions
- Severity of COVID-19 illness
- Underlying health conditions prior to COVID-19
- Lower socio-economic status
- Did not get COVID-19 vaccine

Socioeconomic inequalities of Long COVID-UK. Shabnam et al. 2023 (sagepub.com)
Epidemiology of Long Coronavirus Disease in US Adults | Clinical Infectious Diseases | Oxford Academic (oup.com)
Frontiers | Hospital admission and vaccination as predictive factors of long COVID-19 symptoms (frontiersin.org)
COVID-19 Vaccines and Post-COVID Conditions
COVID-19 vaccination (1 or 2 doses) reduces Post-COVID Conditions compared to no vaccination among those with SARS-CoV-2 infection.
COVID-19 cases diagnosed from March 2021 – February 2022, followed through August 2022

- 161,531 with COVID vaccination prior to infection matched 1:1 with patients without vaccination

**UNPUBLISHED DATA**

Vaccine Safety Datalink

Adjusted RR (95% CI)
COVID-19 mRNA vaccination associated with reduced occurrence of Post COVID Conditions following SARS-CoV-2 infection in a US cohort of adult essential workers, June 2021--September 2022

<table>
<thead>
<tr>
<th>Symptom Category</th>
<th>Total (N =936)</th>
<th>Unvaccinated (n= 157)</th>
<th>Vaccinated 2 doses (≥ 14 days) (n= 301)</th>
<th>Vaccinated 3 doses (≥ 7 days) (n=478)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (Col %) N (Row %)</td>
<td>N (Row %) aOR (95% CI)(^a)</td>
<td>N (Row%) aOR (95% CI)(^a)</td>
<td>N (Row%) aOR (95% CI)(^a)</td>
</tr>
<tr>
<td>1 or more symptoms</td>
<td>221 (23.6) 42 (19.0) 74 (33.5) 1.00 (0.80 - 1.27) 105 (47.5) 0.84 (0.67 - 1.06)</td>
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<tr>
<td>2 or more symptoms</td>
<td>158 (16.9) 27 (17.1) 62 (39.2) 1.22 (0.94 - 1.59) 69 (43.7) 0.76 (0.58 - 0.99)</td>
<td></td>
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<tr>
<td>Cardiovascular symptoms</td>
<td>107 (11.4) 19 (17.8) 44 (41.1) 1.32 (0.98 - 1.78) 44 (41.1) 0.73 (0.54 - 0.99)</td>
<td></td>
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<tr>
<td>Gastrointestinal symptoms</td>
<td>46 (4.9) 12 (26.1) 17 (37.0) 1.04 (0.67 - 1.61) 17 (37.0) 0.60 (0.39 - 0.94)</td>
<td></td>
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<tr>
<td>General symptoms</td>
<td>142 (15.2) 26 (18.3) 58 (40.8) 1.22 (0.94 - 1.60) 58 (40.8) 0.81 (0.62 - 1.05)</td>
<td></td>
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</tr>
<tr>
<td>Neurological symptoms</td>
<td>128 (13.7) 26 (20.3) 44 (34.4) 1.08 (0.81 - 1.43) 58 (45.3) 0.75 (0.57 - 0.99)</td>
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<tr>
<td>Other symptoms</td>
<td>80 (8.5) 19 (23.8) 29 (36.3) 1.08 (0.77 - 1.51) 32 (40.0) 0.68 (0.48 - 0.95)</td>
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</tbody>
</table>

Unpublished data from the HEROES/RECOVER cohort. [HEROES Protocol; RECOVER Protocol]
COVID-19 mRNA vaccination associated with reduced occurrence of Post COVID Conditions following Omicron SARS-CoV-2 infection in a US cohort of children aged 5-17 years, July 2021--September 2022

<table>
<thead>
<tr>
<th></th>
<th>Unvaccinated, 148 (row %)</th>
<th>Vaccinated(^1), 474 (row %)</th>
<th>OR (95% CI)</th>
<th>Adjusted OR(^2) (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or more PCC symptoms</td>
<td>12 (43)</td>
<td>16 (57)</td>
<td>0.63 (0.43 - 0.93)</td>
<td>0.66 (0.43 - 0.99)</td>
</tr>
<tr>
<td>2 or more PCC symptoms</td>
<td>11 (52)</td>
<td>10 (48)</td>
<td>0.52 (0.34 - 0.81)</td>
<td>0.52 (0.32 - 0.83)</td>
</tr>
<tr>
<td>Respiratory PCC symptoms</td>
<td>10 (53)</td>
<td>9 (47)</td>
<td>0.52 (0.33 - 0.82)</td>
<td>0.53 (0.32 - 0.86)</td>
</tr>
<tr>
<td>Non-Respiratory PCC symptoms</td>
<td>10 (42)</td>
<td>14 (58)</td>
<td>0.64 (0.42 - 0.98)</td>
<td>0.70 (0.45 - 1.10)</td>
</tr>
<tr>
<td>PCC Impact on function</td>
<td>9 (56)</td>
<td>7 (44)</td>
<td>0.51 (0.22 - 1.15)</td>
<td>0.62 (0.21 - 1.83)</td>
</tr>
</tbody>
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Unpublished data from the PROTECT cohort. PROTECT Protocol
Summary
Important take home messages

• Post-COVID Conditions are common following SARS-CoV-2 infection, decrease with time since infection, and has decreased since the start of the pandemic

• Symptoms and conditions associated with Post-COVID Conditions are not unique to having had SARS-CoV-2 infection

• Post-COVID Conditions are associated with increased health care utilization and significant activity limitations

• Accumulating evidence that COVID-19 vaccination reduces Post-COVID Conditions among both children and adults