

Short- and Long-Term Impact of COVID-19 Infection on Chronic Health Conditions

Dr. Nirlepkumar Patel M.S Rph*

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***Corresponding author:** Dr. Nirlepkumar Patel M.S Rph, Pharmacist, independat research, Tennessee, USA, E-mail: Nirlepkumar1987@gmail.com

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ABSTRACT

The COVID-19 pandemic has had profound short- and long-term effects on individuals with preexisting chronic health conditions. While initially recognized as a respiratory illness, SARS-CoV-2 has been shown to impact multiple organ systems, exacerbating chronic conditions and complicating recovery. In the short term, individuals with diabetes, hypertension, cardiovascular diseases and respiratory disorders faced heightened risks of severe outcomes, including acute respiratory distress syndrome (ARDS) and organ failure. The strain on healthcare systems further disrupted care for chronic illnesses, while the psychological toll of the pandemic led to widespread anxiety, depression and stigma.

Long-term consequences, often categorized as "Long COVID," include persistent symptoms such as fatigue, cognitive impairment and cardiovascular and pulmonary complications. Long COVID also contributes to metabolic disturbances, autoimmune exacerbations and neurological impairments, including Alzheimer-like changes and vision-related issues. Addressing these impacts necessitates comprehensive post-COVID care, tailored therapies and ongoing research to mitigate the long-term health burden. A multidisciplinary approach integrating physical, mental and social support is critical for improving outcomes and quality of life for affected individuals.

Keywords: COVID-19, Chronic health conditions, Long COVID, Acute respiratory distress syndrome (ARDS), Post-COVID care

1. Introduction

The COVID-19 pandemic has profoundly affected global health, particularly individuals with preexisting chronic health conditions. These impacts, during the acute phase of the Infection and over the longer term, have reshaped our understanding and management of chronic illnesses¹.

Coronaviruses have been known to contribute to human disease since the late 1960s, when they were first identified as causing respiratory illnesses typically associated with mild symptoms of the common cold. Four of the seven characterized human coronaviruses predominantly infect the upper respiratory

tract, leading to mild symptoms. At the same time, the remaining three, including SARS-CoV-2 (the virus responsible for COVID-19), are known for their severe disease-causing characteristics in the lower respiratory tract².

As the COVID-19 pandemic progressed, it became clear that not all patients are affected equally. Variations in symptoms, disease severity, genetic predisposition, age and geographic factors significantly influence the course of the disease and patterns of viral transmission. Individuals with chronic conditions are particularly vulnerable, as the virus often exacerbates underlying health issues, complicating both acute recovery and long-term health outcomes³.

2. Short-Term Impact of COVID-19 on Chronic Health Conditions

2.1. Increased susceptibility to severe outcomes

Individuals with chronic health conditions such as diabetes, hypertension, cardiovascular diseases and respiratory disorders face a significantly higher risk of severe COVID-19 outcomes. This heightened vulnerability is mainly due to compromised immune responses and systemic inflammation in these conditions⁴.

Diabetes: People with diabetes often experience impaired immune function, making it harder to combat infections. During COVID-19, this can lead to severe complications, such as hyperglycemia, diabetic ketoacidosis or multi-organ damage caused by inflammation and infection-induced stress.

Hypertension and Cardiovascular Diseases: Elevated systemic inflammation and vascular dysfunction in these patients exacerbate the severity of COVID-19 symptoms, increasing risks of organ failure and mortality.

The most critical risk factors for developing severe COVID-19 complications, including acute respiratory distress syndrome (ARDS), are diabetes, hypertension and a history of heart disease. Although COVID-19 primarily impacts the lungs, it also significantly affects the cardiovascular system. These underlying health conditions are associated with an increased expression of ACE2 receptors on perivascular pericytes and cardiomyocytes, which the SARS-CoV-2 virus utilizes to gain entry and establish infection⁵.

Cardiovascular disease (CVD) remains the top cause of mortality in the United States, contributing to over 800,000 deaths in 2016. Research, including a meta-analysis conducted in China, indicates that acute cardiac injury occurs in approximately 8% of individuals infected with COVID-19, raising concerns for those with preexisting cardiac or metabolic conditions. Such cardiac complications can present as arrhythmias, myocarditis, cardiogenic shock or heart failure⁶.

Individuals with a history of cardiac issues, such as acute coronary syndrome, angina or myocardial infarction, are particularly vulnerable. Their preexisting conditions not only increase their susceptibility to pneumonia but also compromise their cardiac reserve, making them more prone to severe outcomes when infected with COVID-19⁷.

Respiratory Disorders: Preexisting conditions like asthma or chronic obstructive pulmonary disease (COPD) can lead to greater susceptibility to the respiratory complications of COVID-19, including pneumonia and acute respiratory distress syndrome (ARDS).

The host immune response to COVID-19 shares significant similarities with that seen in acute respiratory distress syndrome (ARDS), suggesting that treatment approaches effective for ARDS may also benefit COVID-19 patients. Clinically, ARDS is characterized by bilateral neutrophilic infiltrates visible on imaging, acute hypoxia and pulmonary edema. This condition arises from a dysregulated immune response with a fibroproliferative component driven by excessive levels of cytokines, chemokines and reactive oxygen species⁸.

Patients with ARDS show markedly elevated levels of proinflammatory cytokines such as interferon-gamma (IFN- γ),

interleukin-6 (IL-6), IL-12 and IL-1 compared to milder COVID-19 cases. Studies on ARDS in mouse models have corroborated these findings, revealing increased concentrations of tumor necrosis factor-alpha (TNF- α), IL-6 and vascular endothelial growth factor (VEGF) in bronchoalveolar lavage fluid, along with decreased levels of the anti-inflammatory cytokine IL-10⁹.

Severe COVID-19 cases similarly exhibit an elevated cytokine profile, indicative of a "cytokine storm." This phenomenon results from an uncontrolled immune response driven by systemic inflammation and hemodynamic instability caused by an abundance of proinflammatory cytokines, including IL-1, IL-6, IL-18, IFN- γ and TNF- α . This excessive cytokine release attracts macrophages, neutrophils and T cells to the lungs, disrupting cell-cell interactions and contributing to the severe lung damage characteristic of ARDS.

Patients with ARDS and severe COVID-19 often suffer from a failed anti-inflammatory response, which exacerbates tissue damage. The inflammatory onslaught causes extensive damage to epithelial and endothelial cells in the lungs, triggering apoptosis and altering alveolar tissue junctions. These changes increase vascular permeability, leading to alveolar fluid leakage and pulmonary edema, a hallmark of ARDS¹⁰.

Further complicating the condition is dysregulated epithelial cell remodeling, which contributes to pulmonary fibrosis—a common cause of mortality in ARDS patients. This fibrosis and the inflammatory damage highlight the need for new therapies targeting the immune response. Nonconventional immunomodulatory approaches that control the overproduction of proinflammatory cytokines could mitigate the accumulation of inflammatory cells and reduce lung tissue destruction. Such strategies offer hope for reducing the severity and mortality associated with ARDS and severe COVID-19 infections¹¹.

2.2. Healthcare disruptions

The immense strain on healthcare systems during the pandemic severely affected the management of chronic diseases. Hospitals and clinics prioritized COVID-19 care, leading to widespread deferral of non-urgent medical appointments and treatments. Examples include:

- **Cancer patients:** Many individuals faced delays in chemotherapy, radiotherapy and surgical interventions, resulting in disease progression or reduced chances of remission.
- **Renal disease patients:** Interruptions in dialysis schedules and delays in kidney transplant procedures left many patients vulnerable to life-threatening complications.
- **Routine check-ups:** Essential monitoring for conditions like hypertension and diabetes was often skipped, leading to suboptimal disease control and worsening symptoms.

These delays compounded the burden on patients, with many experiencing unmanageable complications due to untreated or poorly managed conditions¹².

3. Mental Health Challenges

3.1. Psychological impacts of COVID-19

The COVID-19 pandemic has had far-reaching psychological impacts, affecting individuals across all walks of life. The fear of contracting the virus, referred to as "corona phobia," emerged as a significant mental health challenge, particularly

among healthcare workers and vulnerable populations. This fear, coupled with the uncertainty surrounding the virus, has contributed to widespread stress, anxiety and depression.

Fear and Anxiety

- **Corona phobia:** The intense fear of COVID-19 has become a widespread phenomenon. This fear often manifests as excessive worry about personal health and the safety of loved ones, leading to feelings of helplessness, boredom, loneliness and depression.
- **Anxiety levels:** It is estimated that the mental health of approximately 80% of patients was affected during the pandemic. The absence of definitive treatments for the virus further fueled anxiety, even when symptoms did not meet clinical thresholds for disorders like those in the DSM-5.

3.2. Other common psychological disorders

The pandemic created a fertile ground for various mental health issues:

- **Stress and depression:** Lockdowns, loss of routine and fears about the future resulted in high levels of stress and depressive symptoms in many individuals.
- **Long-term consequences:** Persistent anxiety, uncertainty and stressors have the potential to erode social networks, increase stigma and contribute to heightened emotional states, potentially leading to psychosis, mood disorders, phobias, panic disorders and sleep disturbances¹³.

3.3. Stigma and social isolation

COVID-19 heightened stigma against individuals of specific ethnic backgrounds and those suspected of having contact with infected persons. This stigma led to underlying social Relationships, which affected isolated individuals and damaged community ties; fear of being stigmatized caused people to hide their symptoms or avoid seeking healthcare promptly, exacerbating health outcomes and delaying the symptoms.

The COVID-19 pandemic has underscored the critical need for a comprehensive approach to mental health. Addressing these psychological impacts requires collaboration between healthcare providers, communities and policymakers to ensure that individuals, particularly vulnerable populations, receive the support they need to navigate these challenges.

This mental health strain created a feedback loop where emotional distress negatively impacted physical health. For example, stress-related behaviors like overeating or neglecting medications often worsen diabetes or cardiovascular diseases. Similarly, depression and anxiety impair patients' ability to adhere to treatment regimens, exacerbating their chronic conditions¹⁴.

3.4. Long-term impact of COVID-19 on health

The long-term consequences of COVID-19 extend beyond the acute phase of the illness, significantly impacting various aspects of health and exacerbating preexisting conditions. These effects, often grouped under the umbrella term "Long COVID" or post-acute sequelae of SARS-CoV-2 infection (PASC), highlight the persistent challenges individuals face recovering from the virus.

3.5. Emergence of long COVID

Long COVID refers to a range of symptoms that persist

weeks or months after the initial Infection. These symptoms, which include fatigue, shortness of breath and cognitive difficulties, often complicate recovery and disease management with Overlap with Chronic Conditions such as fibromyalgia or chronic fatigue syndrome, frequently experience worsening symptoms, such as intensified pain or prolonged fatigue and Impacted Daily Life¹⁵.

3.6. Circulatory system disruption

COVID-19 causes significant Disruption to the circulatory system, with effects including Endothelial Dysfunction, which is caused by the triggering of the virus, which damages the endothelial lining of blood vessels and causes widespread vascular complications. This dysfunction further contributes to Increased Risks of Thrombosis, where patients experience heightened risks of deep vein thrombosis (DVT) and pulmonary embolism, conditions linked to clot formation in veins and arteries. Disruption of normal coagulation pathways increases susceptibility to hemorrhagic complications.

Furthermore, Changes in Blood Cell Properties are one of the common long-term effects leading to changes in the size and stiffness of blood cells and these alterations can impair oxygen delivery, leading to fatigue, poor physical performance and tissue hypoxia in patients. Reduced vascular density is one of the conditions associated with long-term COVID-19, with a reduction in the density of tiny capillaries. Studies have shown significant decreases even 18 months post-infection. This reduction impairs microcirculation, particularly affecting the ability of small blood vessels to deliver oxygen and nutrients effectively to tissues¹⁶.

3.7. Cardiovascular complications

COVID-19 has been linked to a range of long-term cardiovascular issues, posing significant risks to individuals both with and without preexisting heart conditions:

- **Persistent myocardial inflammation:** Inflammation of the heart muscle can cause lingering chest pain, arrhythmias or heart failure.
- **Increased risk of thrombosis:** Prolonged hypercoagulability observed in some patients increases the likelihood of heart attacks and strokes, even months after recovery.
- **Accelerated atherosclerosis:** For those with coronary artery disease, COVID-19 can hasten the progression of atherosclerosis, worsening cardiovascular health¹⁷.

3.8. Pulmonary health decline

COVID-19's impact on the lungs often results in long-term respiratory challenges, particularly for individuals with preexisting conditions like asthma or chronic obstructive pulmonary disease (COPD):

- **Lung function decline:** Persistent inflammation and damage to lung tissues can reduce respiratory capacity.
- **Pulmonary fibrosis:** In severe cases, virus-induced scarring of lung tissues results in pulmonary fibrosis, leaving some patients reliant on supplemental oxygen or mechanical ventilation.
- **Breathlessness:** Many individuals report ongoing shortness of breath that limits physical activity and daily functioning⁹.

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