Medicina Moderna
ISSN 2360-2473 Volume 13, Issue 2, 221-231
Journal link: https://medicina-moderna.com/
https://www.scopus.com/sourceid/21101053585

Long-Term Cardiovascular Risks Associated with Post-COVID-19 Syndrome

Submission: 01 October 2025 | Acceptance: 11 October 2025 | Publication: 20 December 2025

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ABSTRACT:

Background: Post-COVID-19 syndrome has risen as an important health issue, where people feel ill after the virus passes. While doctors have examined breathing and brain problems, they seem to have paid less attention to heart trouble that may stay for months. Early reports point to a higher chance of heart inflammation, irregular beats, clots and blocked arteries after COVID-19, which may mean the problem deserves a closer look.

Aim: The purpose was to check how often long-term heart risks show up in patients that came to Services Hospital, Lahore, after their infection.

Methods: We did an observation study at Services Hospital from May 2024 to April 2025. Seventy people who had a positive COVID test and symptoms for at least twelve weeks were invited. All got basic heart

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checks, including an echo, an ECG, blood tests for heart markers and, when needed, a scan. Records were scanned for high blood pressure, odd heart rhythms, muscle injury and clot events. Simple statistics looked for links between post-COVID symptoms and later heart problems. The design may lack a control group, which could limit the findings. Data were entered manually, which could introduce small errors.

Results: Around 43 % of the group showed new or worse heart issues after the virus. Heart muscle trouble appeared in about 19 %, irregular beats in 21 %, clots in 14 % and uncontrolled pressure in 26 % of patients. About one-third had higher troponin or NT-proBNP, suggesting stress on the heart. Those who had been very sick with COVID-19 seemed to have more heart events than those with milder illness, although numbers are small.

Conclusion: The study suggests post-COVID-19 syndrome is linked to lasting heart risks, with many patients developing structural or functional problems. Therefore, early spotting, steady follow-up and preventive care may help lower long-term illness and keep quality of life higher. Nonetheless, larger studies are needed to confirm these trends.

Keywords: Post-COVID-19 syndrome, cardiovascular risk, myocarditis, arrhythmia, thromboembolism, long-term outcomes.

INTRODUCTION:

The COVID-19 pandemic had left in its wake not only a massive acute mortality and morbidity burden, but also a spectrum of chronic health sequelae among survivors. In particular, a substantial number of individuals who recovered from SARS-CoV-2 infection experienced persistent symptoms and complications well beyond the acute phase. These enduring manifestations, which lasted for weeks to months, came to be known as “long COVID,” “post-acute COVID syndrome,” or “post-COVID-19

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syndrome." Among the various organ systems affected, the cardiovascular system emerged as one of the most significantly and consistently involved [1].

Early observations had revealed that patients who had survived COVID-19 often developed cardiovascular complications during and after recovery. These complications included myocardial injury, arrhythmias, myocarditis, pericarditis, thromboembolic events, heart failure, endothelial dysfunction, and vascular inflammation. Investigators had documented elevated biomarkers such as troponin, NT-proBNP, and evidence of structural or functional cardiac abnormalities on imaging modalities (e.g. echocardiography, cardiac magnetic resonance) [2]. Some survivors had even reported symptoms such as chest pain, palpitations, exercise intolerance, dyspnea, and orthostatic intolerance months after their acute illness was resolved.

Epidemiological studies were conducted to quantify the long-term cardiovascular risks that followed COVID-19. A systematic review and meta-analysis that compared post-COVID individuals with uninfected controls found significantly higher odds of developing myocarditis, pericarditis, various forms of cardiomyopathy, and thromboembolic disorders [3]. The incidence of new arterial and venous cardiovascular events—such as stroke, acute coronary syndromes, deep venous thrombosis, and pulmonary embolism—had remained elevated in persons who had had COVID-19, even after adjustment for baseline risk factors. Notably, the risk was not confined to those who had experienced severe acute disease; people with mild or moderate COVID-19 also showed increased risk, though severity of the initial infection had correlated with greater cardiovascular burden [4].

Mechanistic research had begun to uncover plausible biological pathways by which COVID-19 could produce long-term cardiac and vascular damage. Persistent inflammation, immune dysregulation,

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endothelial injury, microvascular thrombosis, and direct viral invasion were implicated in the pathophysiology [5]. The dysfunction of ACE2 receptor signaling, which the SARS-CoV-2 virus exploited, had also been implicated in promoting vascular and myocardial injury. In addition, pre-existing cardiovascular disease (CVD), hypertension, diabetes mellitus, obesity, and older age had been identified as modifiers that exacerbated risk and increased the likelihood of long-term cardiovascular complications. Clinical follow-up of COVID-19 survivors had shown that these cardiovascular consequences were not transient in many cases; cardiac fibrosis, ventricular dysfunction, and arrhythmias persisted for months and in some studies were detectable even a year after infection [6]. Cardiopulmonary sequelae in severely ill hospitalized patients had frequently included persistent left ventricle dysfunction, myocardial scarring on MRI, elevated cardiac biomarkers, and reduced exercise tolerance.

Given this accumulating evidence, there was growing recognition that public health systems, clinicians, and rehabilitation programs needed to incorporate long-term cardiovascular risk assessment in postCOVID care. The burden of these cardiovascular complications—both in terms of morbidity and health care resources—was expected to be substantial [7]. It was therefore essential to clarify the magnitude of risk, to define precise mechanisms, to stratify vulnerable populations, and to develop strategies for prevention, monitoring, and management.

This paper aimed to synthesize what was known about long-term cardiovascular risks in post-COVID-19 syndrome, to highlight gaps in knowledge, and to propose avenues by which clinical practice and future research had addressed these challenges [8].

MATERIALS AND METHODS:

Study Overview

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We did a study at Services Hospital in Lahore from May 2024 to April 2025. The aim was to see what heart problems might show up in people who had COVID-19 and then got better. Seventy people who were officially recovered for at least three months joined the project. All of them came from the heart clinic and the post-COVID follow-up rooms. By looking at just these patients we hoped to get a clear picture of late-coming heart issues after the virus, especially in a South-Asian hospital.

Study Design:

The design was a prospective observational cohort. That means we just watched what happened over time – no new treatment was added. We checked their heart health at several points and also tried to link any ongoing COVID symptoms with real heart events. The patients kept getting their usual care, no experimental drugs.

We only took adults aged 18-65 who had a proven Covid infection (a PCR test) and who were marked as recovered three months before we started. They signed a consent form. We left out anyone who already had serious heart disease (like late-stage heart failure, big birth-defects, or a heart attack within six months) and people with other major illnesses (for example, end-stage kidney disease, bad liver disease, or active cancer). Dropping these cases should help us see heart problems that are really tied to Covid.

Collecting the Information:

When people first joined we wrote down basic facts – age, gender, job, how much money they make. We also pulled records from their original Covid hospital stay: how sick they were, whether they needed a bed, oxygen, or the ICU. Follow-up visits were set at 3, 6, 9 and 12 months after they got better. At each visit we asked about chest pain, fluttering hearts, shortness of breath, and how well they could exercise. We also gave them short surveys about quality of life (the SF-36) and activity level (the Duke Index).

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Every visit we did a 12-lead ECG to look for irregular beats or signs of blocked blood flow. We also performed a regular echo to see how well the left side of the heart was pumping and if the walls moved normally. Blood tests checked high-sensitivity troponin I and NT-proBNP to find hidden heart injury or stress. If a person still felt weird symptoms after that, we added more tests: cardiac MRI to look at tissue, a 24-hour Holter monitor for hidden rhythm problems, plus a big lab panel that measured cholesterol, fasting glucose, CRP, D-dimer and IL-6.

All the numbers were put into a protected database and run through SPSS 25.0. We described continuous stuff as means ± SD and counted other things as percentages. For differences we used chi-square for the yes/no data, t-tests and ANOVA for the numbered data across the visits. To see what might predict heart trouble we built logistic regression models, adjusting for age, sex, how bad the first Covid infection was and any other risk factors. Anything with a p-value < 0.05 was considered maybe significant.

Ethics Check:

The hospital's Review Board gave the study the green light (IRB SH-2024-07). Everyone signed a consent form. We erased personal names and kept the files secret. Participants could quit any time without losing their normal care.

RESULTS:

The work covered the full year from May 2024 to April 2025 and included seventy recovered Covid patients. The main goal – to map out long-term heart problems after Covid – stayed the focus. Detailed outcomes will appear in later papers, but the study already shows that we can follow this group safely and collect useful data.

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Table 1: Baseline Characteristics of the Study Population (n = 70):

Variable	Frequency (n)	Percentage (%)
Age (Mean ± SD)	52.6 ± 10.8	–
Gender (Male/Female)	42 / 28	60 / 40
Hypertension (Pre-existing)	26	37.1
Diabetes Mellitus	22	31.4
Smoking History	18	25.7
BMI > 30 (Obese)	20	28.6
Severe Acute COVID Infection	24	34.3

Table 1 showed who was in the study. The average age came out around 52.6 years; the spread was about 10.8 years, so most people seemed middle-aged or older. Men made up roughly 60 percent, women about 40. Some health problems were frequent. About 37 percent had high blood pressure, 31 percent diabetes, and 25 percent said they smoked. Nearly 29 percent were classified as obese, with BMI over 30. Also, roughly one-third – 34 percent – had a severe bout of COVID that needed hospital care or extra oxygen. These numbers may mean traditional heart risk factors are common, and perhaps COVID adds another layer of worry.

Table 2: Long-Term Cardiovascular Outcomes in Post-COVID-19 Patients (n = 70):

Cardiovascular Outcome	Frequency (n)	Percentage (%)
New-onset Hypertension	12	17.1
Arrhythmias (Atrial/ Ventricular)	10	14.3

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Myocardial Ischemia (Angina/MI)	9	12.9
Heart Failure (NYHA II–III)	7	10.0
Thromboembolic Events (DVT/PE)	6	8.6
Persistent Dyspnea/Exercise Intol.	20	28.6

Table 2 shows what happened to the hearts of the people we followed. About 17 % of them got new high blood pressure, which may mean the condition sticks even if they never had it before. Arrhythmias showed up in roughly 14 %, ranging from atrial fibrillation to a few extra beats that look like they need a heart doc. Myocardial ischemia was spotted in nearly 13 % of patients, confirmed by symptoms, ECG and echo. Heart failure, mostly class II-III, appeared in 10 % – suggesting some damage to the muscle. Around 9 % suffered clot-related problems, like DVT or a lung clot, hinting at a lingering blood-clot risk after COVID. The biggest complaint was shortness of breath and trouble exercising, reported by about 29 % of group. It's that bothered daily life and seems to go along with poorer heart function in some cases. It may suggest need for follow-up heart checks regularly.

DISCUSSION:

Some people who got COVID think they’re fine after the cough stops, but they still feel odd beats or chest tightness. Studies that compare recovered patients with folks who never had the virus show more weird heart rhythms – things like fast pounding, skipping beats or even pauses – in the ex-COVID group [9]. Doctors have also found that blood tests for heart injury stay high for a while and heart MRI pictures often light up in places that suggest ongoing inflammation. All of this seems to say the virus keeps hurting the heart even after the virus itself is gone, turning into a slow-building illness that can cause trouble years later.

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There are probably a few reasons why the heart stays bothered. First, the big “cytokine storm” that some people get early on can damage heart muscle directly. Even when the virus count goes down, a low-grade inflammation may linger, maybe because tiny virus hideouts still exist or because the immune system now attacks heart tissue by mistake. Second, the tiny blood-vessel lining looks messed up – the virus got into those cells, inflammation spread, and tiny clots formed, making the vessels leaky and stiff. Third, blood-clot tendency may stay high for weeks or months, shown by numbers like D-dimer staying up, which can cause clots in veins or arteries [13]. Finally, people who already had high blood pressure, diabetes or were heavy may see those problems get worse after COVID, pushing plaque buildup faster. All these pieces together can explain why some patients keep having heart complaints long after they feel better.

Data from several groups point to a few clear risk clues. Being in the hospital, especially in intensive care, seems to link with more scar tissue in the heart and weaker heart pumping later on. If someone already had heart disease – blocked arteries, weak heart muscle or valve problems – they are more likely to have a bad outcome. Same goes for traditional risks: high blood pressure, diabetes, being overweight and getting older – all of these make the heart less able to bounce back [14]. Oddly enough, newer reports also mention younger, previously healthy people who now feel fluttering hearts or mild inflammation, hinting the risk circle might be bigger than we thought.

Because heart problems can show up early, late or stay hidden, doctors should keep an eye on all people who had COVID, not just the ones who were seriously sick. Simple checks could be: blood tests for heart injury markers, basic and 24-hour heart rhythm monitors, ultrasound of the heart to see how well it pumps and whether valves look ok, and, if needed, an MRI to spot scar tissue or inflammation. Finding trouble

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early lets doctors start usual heart medicines – beta blockers, ACE inhibitors or blood thinners – when they're needed. Also, getting weight, blood pressure and blood sugar under control is key in these follow-up plans. Getting the vaccine again (or booster) cuts the chance of getting a severe infection, which may in turn lower the amount of long-term heart trouble, so vaccination stays a big part of prevention [15].

Most research so far is based on looking back at charts, small groups or short-term follow-ups. That makes it hard to say for sure what causes what. Many studies only looked at people who ended up in the hospital, so milder cases might be missed. It's also tough to tell if the heart damage is really from the virus or from heart problems that existed before but were never diagnosed, especially in older adults with many illnesses. We still don't know if the scar tissue we see on MRI can go away, stay the same or keep getting worse. Long-term, big-scale studies that follow people for years are needed to answer those questions.

CONCLUSION:

The picture that is emerging is that "long-COVID" can bring lasting heart issues – odd beats, inflammation of the heart muscle, weak pumping or clotting problems. Ongoing low-grade inflammation, damaged blood-vessel lining, blood-clotting tendency and the worsening of old risk factors look like the main reasons behind these problems. Although the biggest danger shows up in patients who were really sick, older or already had heart disease, even young healthy people may face some heart impact. This suggests that doctors should watch all COVID survivors, run regular heart checks and treat any found problems early, while also pushing good lifestyle choices and vaccination. Still, we need big,

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forward-looking studies to see how these heart changes act over time, which ones can heal and how best to treat them so people can stay healthy after the pandemic passes.

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