e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(8); 878-882

Original Research Article

High-Sensitivity C-Reactive Protein in Post-COVID Adults

Sreemanta Madhab Baruah[1], Shyamjith Lakshmanan B.[2], Mriganka Shekhar Chaliha[3], Rashmi Rajkakati[4], Anish Hazra[5]

[1]Associate Professor, Department of General Medicine, Assam Medical College, Dibrugarh, Assam, India
[2]Postgraduate Trainee, Department of General Medicine, Assam Medical College, Dibrugarh, Assam, India
[3]Professor & HOD, Department of Cardiology, Assam Medical College, Dibrugarh, Assam, India
[4]Professor & HOD, Department of Biochemistry, Assam Medical College, Dibrugarh, Assam, India
[5]Postgraduate Trainee, Department of General Medicine, Assam Medical College, Dibrugarh, Assam, India

Received: 17-06-2025 / Revised: 16-07-2025 / Accepted: 17-08-2025
Corresponding Author: Dr. Shyamjith Lakshmanan B.
Conflict of interest: Nil

Abstract:

Background: The COVID-19 pandemic has resulted in significant health impacts, including a rise in cardiovascular complications like myocarditis and sudden cardiac death, particularly in the post-COVID era. Inflammation, indicated by elevated hs-CRP levels, is a key factor in these conditions. This study compares hs-CRP levels between post-COVID and non-COVID adults to identify individuals at higher cardiovascular risk and facilitate timely clinical intervention.

Methods: This hospital-based observational cross-sectional study was conducted in the Department of Medicine, AMCH, Dibrugarh, from November 2023 to October 2024. It included 90 post-COVID adults who were hospitalized for COVID-19 infection and 90 adults with no history of clinical COVID-19. Data collection involved history taking, clinical examination, and serum hs-CRP assessment using an ELISA kit.

Results: The study included participants aged 20–60 years, with most in the 41–50 age group. Males predominated in both post-COVID (53.33%) and non-COVID (61.11%) groups. Elevated hs-CRP was significantly more frequent in post-COVID individuals (38.89%) compared to non-COVID (10.00%). Mean hs-CRP levels were slightly higher post-COVID, with overall differences statistically significant. Symptom analysis revealed that post-COVID individuals experienced more exercise intolerance (28.89%), fatigue (27.78%), and palpitations (12.22%), with significant associations between raised hs-CRP and both exercise intolerance ($p=0.004$) and fatigue ($p=0.005$). In contrast, symptoms in non-COVID individuals showed no significant correlation with hs-CRP. These findings highlight persistent inflammation and higher symptom burden post-COVID.

Conclusion: The study found significantly higher hs-CRP levels in post-COVID individuals, indicating persistent systemic inflammation. Since prolonged hs-CRP elevation is linked to cardiovascular risks such as atherosclerosis and myocardial infarction, the findings highlight the need for routine cardiovascular assessment and long-term follow-up in post-COVID patients to prevent future complications.

Keywords: Post COVID, hs-CRP (High Sensitivity C Reactive Protein), Inflammation, Sudden Cardiovascular Death.

Introduction

The COVID-19 pandemic, caused by SARS-CoV-2, emerged in Wuhan in December 2019 and led to severe global health, economic, and social impacts. By 2021, over 690 million infections and 6.8 million deaths were reported worldwide.[1] India documented over 4.4 million cases, including 8,000 deaths in Assam.[2] While vaccination reduced severe outcomes,[3] COVID-19 has been linked to cardiovascular complications such as myocarditis, arrhythmias, acute coronary syndrome, and sudden cardiac death (SCD).[4]

Post-COVID individuals, especially young adults without comorbidities, show increased risk of SCD, possibly due to persistent vascular inflammation and endothelial dysfunction.[5] coronary artery disease has also been noted more frequently after infection. High-sensitivity C-reactive protein (hs-CRP), a marker of systemic inflammation and cardiovascular risk, may remain elevated in post-COVID patients, indicating unresolved inflammation and risk of atherosclerosis or myocardial infarction.[6] This study compares hs-CRP levels in post-COVID and

non-COVID adults to guide early interventions and improve long-term cardiac care.

Aim & Objectives: The present study was carried out in the Department of Medicine, Assam Medical College & Hospital, Dibrugarh with the following aim & objectives.

Aim: To estimate hs-CRP level in post-covid adults and in non-covid adults.

Objectives

1. To determine the association of hs-CRP with post-covid adults and non-covid adults.
2. To compare the proportion of raised hs-CRP level in post-covid adults and in non-covid adults.

Materials and Methods

Place of Study: The current Hospital based cross sectional comparative study was conducted in the department of General Medicine, Assam Medical College and Hospital, Dibrugarh for a period of One year (November 2023 to October 2024).

Study Population: All patients aged 18 to 59 years who had been hospitalized for COVID infection, and adults aged 18 to 59 years with no history of COVID infection.

Inclusion Criteria

- Patients with 18 to 59 years of age who were hospitalized with COVID infection.
- Patients with 18 to 59 years of age, without history of COVID infection.

Exclusion Criteria

- Patients with hypertension, diabetes mellitus.
- Patients with known heart disease.
- Patients with COPD, chronic kidney disease, chronic liver disease.
- Patients with any other known chronic illness.
- Patients with known autoimmune diseases.
- Patients with any acute infection.
- Patients who have not taken two doses of the COVID vaccine.
- Patients who do not give consent.

Sample Size: The sample size was calculated using the formula for estimating the difference between two population proportions. Anticipated proportions for post-COVID (P1) and non-COVID (P2) groups were both taken as 0.5, as limited prior studies were available. The intermediate variance value was calculated as $V = P1(1–P1) + P2(1–P2) = 0.587$. Using the formula $n = Z^2V / d^2$, with $Z = 1.96$ (95% confidence interval) and allowable error (d) = 15%, the minimum required sample size was 86 per group. This was rounded to 90 participants in each group, giving a total final sample size of 180 individuals.

Study Method

The study was conducted over one year at Assam Medical College and Hospital, Dibrugarh. Adults previously hospitalized with COVID-19 were identified from the registry and contacted for follow-up, while vaccinated individuals without prior infection were recruited from the general population and OPD. Informed consent was obtained, and data were collected using a structured proforma covering demographic details, medical history, comorbidities, lifestyle habits, vaccination status, and present complaints. Patients with known chronic illnesses such as hypertension, diabetes, COPD, or prior cardiac disease were excluded.

A thorough clinical examination assessed general condition and systemic evaluation of cardiovascular, respiratory, nervous, and gastrointestinal systems. Vital parameters including pulse and blood pressure were recorded.

All participants underwent investigations including complete blood count, renal function tests, serum electrolytes, chest X-ray, ECG, and hs-CRP estimation. Haematological and biochemical tests were performed using automated analyzers in AMCH laboratories. Serum hs-CRP was measured using a sandwich ELISA technique from Multi-Disciplinary Research Unit, AMCH. Venous blood samples were centrifuged, and serum stored at –80°C until analysis. Assay involved dilution of samples (1:100), incubation with anti-CRP biotin-HRP conjugate, washing, and addition of TMB substrate, followed by absorbance measurement at 450 nm using an ELISA reader. A standard curve was generated to calculate concentrations, and values ≥0.1 mg/L were considered raised.

Statistical Analysis: Statistical analysis was conducted using SPSS for Windows, version 21.0. Data were collected through a pre-tested form and analysed using appropriate statistical methods based on the type of data. Graphs and tables were prepared using Microsoft Word and Excel. Quantitative data were analysed using Student's t-test and ANOVA, while the Pearson correlation coefficient (r) was applied for continuous variables. A p-value of less than 0.05 was considered statistically significant.

Results and Analysis

Table 1: Age Wise Distribution

Age in Years	Post COVID		Non-COVID		P-Value
	N	%	N	%	
≤20	7	7.78	12	13.33	**0.**10841
21-30	16	17.78	18	20.00	
31-40	23	25.56	21	23.33	
41-50	31	34.44	30	33.33	
51-60	13	14.44	9	10.00	
Mean±SD	38.82±10.79		36.17±11.29		

Most participants in both groups are aged 41–50. The post-COVID group has a slightly higher average age (38.82 years) compared to the non-COVID group (36.17 years). Younger individuals (≤20 and 21–30) are more common in the non-COVID group.

Table 2: Gender Wise Distribution

Gender	Post COVID		Non-COVID		P-Value
	N	%	N	%	
Male	48	53.33	55	61.11	>0.05
Female	42	46.67	35	38.89	

Males are more prevalent in both groups, comprising 53.33% in the post-COVID group and 61.11% in the non-COVID group, while females make up 46.67% and 38.89%, respectively.

Table 3: hs-CRP Levels in Post-COVID vs Non-COVID Individuals

hs-CRP	Post COVID		Non-COVID		P-Value
	N	%	N	%	
Raised	35	38.89	9	10.00	**<0.0001**
Normal	55	61.11	81	90.00	

Elevated hs-CRP levels are more common in post-COVID individuals (38.89%) than in non-COVID individuals (10.00%), with a highly significant p-value (<0.0001).

Table 4: Comparison of Mean hs-CRP Levels

hs-CRP	Post Covid		Non-COVID		P-Value
	MEAN	SD	MEAN	SD	
Normal	0.05	0.02	0.04	0.02	0.002949
Raised	0.33	0.15	0.29	0.09	0.441011
P-Value	**0.0001**		**0.0001**		

The post-COVID group has slightly higher hs-CRP levels than the non-COVID group. The p-value for normal hs-CRP levels (0.0029) is statistically significant, while that for raised levels (0.4410) is not. The overall p-value (0.0001) indicates a significant difference between the groups.

Table 5: Analysis of Common Symptoms

Symptoms	Post COVID		Non-COVID		P-Value
	N	%	N	%	
Exercise Intolerance	26	28.89	7	7.78	0.0003
Excessive Fatigue	25	27.78	9	10.00	0.0023
Palpitation	11	12.22	2	2.22	0.0095
Chest pain	6	6.67	1	1.11	0.0538
Respiratory Distress	5	5.56	1	1.11	0.0966

Post-COVID individuals exhibit a higher symptom burden, with significantly increased rates of exercise intolerance (28.89% vs. 7.78%), excessive fatigue (27.78% vs. 10.00%), and palpitations (12.22% vs. 2.22%). Chest pain (6.67% vs. 1.11%) and respiratory distress (5.56% vs. 1.11%) are also more prevalent but less statistically significant.

Table 6: Relationship between hs-CRP Levels and Symptoms in Post-COVID Patients

Symptoms	Raised hs-CRP		Normal hs-CRP		P-Value
	N	%	N	%	
Exercise Intolerance	21	23.33	7	7.78	0.004
Excessive Fatigue	19	21.11	6	6.67	0.005
Palpitation	6	6.67	5	5.56	0.751
Chest pain	5	5.56	1	1.11	0.096
Respiratory Distress	2	2.22	3	3.33	0.646

Exercise intolerance and excessive fatigue are significantly more common in individuals with elevated hs-CRP levels, while other symptoms like palpitations, chest pain, and respiratory distress show no significant difference. This suggests a potential association between high hs-CRP and greater post-COVID symptom burden.

Table 7: Relationship between hs-CRP Levels and Symptoms in Non-COVID Individuals

Symptoms	Raised hs-CRP		Normal hs-CRP		P-Value
	N	%	N	%	
Exercise Intolerance	4	4.44	3	3.33	0.698
Excessive Fatigue	1	1.11	4	4.44	0.173
Palpitation	0	0	1	1.11	0.314
Chest pain	0	0	1	1.11	0.314
Respiratory Distress	3	3.33	1	1.11	0.312

In non-COVID individuals, symptoms like exercise intolerance, fatigue, palpitations, chest pain, and respiratory distress occur at similar rates across groups, with no significant differences. This indicates that hs-CRP levels are not strongly linked to symptom prevalence in this population.

Discussion

This observational cross-sectional study was conducted at Assam Medical College and Hospital (AMCH), Dibrugarh. A total of 180 adults who met the defined inclusion and exclusion criteria were enrolled, comprising 90 post-COVID individuals and 90 non-COVID individuals

Demographic Distribution: Age distribution was comparable between groups, with the highest proportion in the 41–50 age range. The mean age of the post-COVID group (38.82 years) was slightly higher than that of the non-COVID vaccinated group (36.17 years), consistent with previous findings by Mugundhan Kandhasami et al.[7] and Pérez et al. who observed older age groups were more common among post-COVID individuals.[8] In contrast, a 2022 study by Khatib et al. in Ireland reported that 84.1% of patients were below 40 years.[9]

Gender-wise, males were more prevalent in both groups: 53.33% in the post-COVID group and 61.11% in the non-COVID vaccinated group. Studies by Takahashi et al. suggest that men tend to experience more severe COVID-19 outcomes due to immune and hormonal differences, with a higher risk of post-infection inflammation.[10] However, Danning Wu et al. reported a near-equal gender distribution in different age categories,[11] while Khatib et al. observed a predominance of female participants (72%) in their 2022 Irish study.[9]

hs-CRP and Cardiovascular Risk in Post-COVID Individuals: The current study found significantly higher hs-CRP levels in the post-COVID group (38.89%) compared to the non-COVID vaccinated group (10.00%), indicating persistent systemic inflammation in the post-COVID population. This supports findings by Libby et al. (2002),[7] who associated prolonged immune activation with chronic inflammation, contributing to cardiovascular disease through mechanisms like atherosclerosis, thrombosis, and endothelial dysfunction.

Studies by González-Dias et al.[12] and meta-analyses by Wang et al. (2021) revealed that elevated CRP levels are strongly associated with severe COVID-19 and poor outcomes.[13] Ridker et al. highlighted hs-CRP as a predictive marker for cardiovascular events, while Perry et al. (2022) confirmed its link with acute coronary syndrome and myocardial infarction.[14] The current study's findings align with these, suggesting a prolonged inflammatory response in post-COVID individuals.

Zhang et al. (2022) linked COVID-19 to endothelial dysfunction, a factor in atherosclerosis and thrombosis,[15] which is supported by the persistent hs-CRP elevation observed in this study. Liu et al. (2022) emphasized that vaccine-induced inflammation is short-lived, unlike the sustained inflammation in post-COVID cases.[16] Lionte C et al. proposed that residual viral particles in post-COVID tissues may sustain inflammation, contributing to elevated hs-CRP levels and increasing cardiovascular risk and further noted that COVID-19-related hypercoagulability, along with inflammation-induced platelet aggregation and

endothelial dysfunction, can amplify the risk of thrombosis.

Limitations

- The shorter duration of the study.
- Small study population.
- The study subjects may not be a true representation of the whole population

Conclusion

The study shows that elevated hs-CRP levels are significantly higher in post-COVID individuals than in non-COVID individuals. As a sensitive marker of systemic inflammation, this finding suggests the presence of persistent inflammatory processes in post-COVID adults. Prolonged elevation of hs-CRP is a well-established risk factor for cardiovascular diseases, as it contributes to endothelial dysfunction, plaque formation, and plaque instability, which can lead to serious conditions such as atherosclerosis, myocardial infarction, and sudden cardiac death. These findings underscore the importance of routine cardiovascular risk assessment and long-term follow-up in post-COVID patients to identify and manage potential complications early-ultimately aiming to reduce the burden of post-COVID cardiovascular morbidity.

References

1. World Health Statistics 2022: Monitoring Health for the SDGs, Sustainable Development Goals. 1st ed. Geneva: World Health Organization 2022: p. 1.
2. Website of Health & Family Welfare Department of Assam| National Portal of India [Internet]. [Cited 2025 Mar 21]. Available from: https://www.india.gov.in/website-health-family-welfare-department-assam.
3. Overview-of-the-implementation-of-COVID-19-vaccination-strategies-and-deployment-plans-14-June-2021.pdf [Internet]. [Cited 2025 Mar 21]. Available from: https://www.ecdc.europa.eu/sites/default/files/documents/Overview-of-the-implementation-of-COVID-19-vaccination-strategies-and-deployment-plans-14-June-2021.pdf
4. Shi S, Qin M, Shen B, et al. Association of cardiac injury with mortality in hospitalized patients with COVID-19 in Wuhan, China. JAMA Cardiology 2020;5(7):802-10.
5. SARS-CoV-2 infects coronary arteries, increases plaque inflammation [Internet]. National Institutes of Health (NIH). 2023 [cited 2025 Mar 21]. Available from: https://www.nih.gov/news-events/news-releases/sars-cov-2-infects-coronary-arteries-increases-plaque-inflammation.
6. Yadav R, Bansal R, Budakoty S, et al. COVID-19 and sudden cardiac death: a new potential risk. Indian Heart J 2020;72(5):333-6.
7. Zieneldien T, Kim J, Cao J, et al. COVID-19 Vaccines: Current Conditions and Future Prospects. Biology 2021;10(10):960.
8. Nishiga M, Wang DW, Han Y, et al. COVID-19 and cardiovascular disease: from basic mechanisms to clinical perspectives. Nat Rev Cardiol 2020;17(9):543-58.
9. Khatib S, Sabobeh T, Habib A, et al. Post-COVID-19 fatigue as a major health problem: a cross-sectional study from Missouri, USA. Ir J Med Sci 2023;192(2):699–705.
10. Lionte C, Sorodoc V, Haliga RE, et al. Inflammatory and cardiac biomarkers in relation with post-acute covid-19 and mortality: what we know after successive pandemic waves. Diagnostics 2022;12(6):1373.
11. Liu Z, Wu D, Han X, et al. HsCRP Variation is the Main Risk Factor for Clinical Outcome in COVID-19 Hospitalized Young and Middle-Aged Patients [Internet]. 2020 [cited 2025 Mar 25]. Available from: https://www.researchsquare.com/article/rs-40110/v1
12. Kandhasami M, Panchanathan S, Rajendran J, et al. High Sensitivity C-Reactive Protein as a Prognostic Indicator of Cardiovascular Disease in Severe Non-Diabetic COVID-19 Patients. Discoveries 2023;11(3):e172.
13. Wang L, Yang LM, Pei SF, et al. CRP, SAA, LDH, and DD predict poor prognosis of coronavirus disease (COVID-19): a meta-analysis from 7739 patients. Scandinavian Journal of Clinical and Laboratory Investigation 2021;81(8):679-86.
14. Perry KJ, Mutignani LM, Gissandaner TD, et al. Testing an integrated dimensional model of adverse childhood experiences: Associations with COVID-19 outcomes. Child Abuse Negl 2023; 143:106239.
15. Xia S, Zhang Y, Wang Y, et al. Safety and immunogenicity of an inactivated COVID-19 vaccine, BBIBP-CorV, in people younger than 18 years: a randomised, double-blind, controlled, phase 1/2 trial. The Lancet Infectious Diseases 2022;22(2):196–208.
16. Datar RS, Fette LM, Hinkelman AN, et al. Factors associated with COVID-19 vaccination during June–October 2021: a multi-site prospective study. Vaccine 2023;41(20):3204–14.