



## Significance of Serum C-Reactive Protein in Assessing the Severity of Covid Illness Among Vaccinated and Non-Vaccinated Individuals

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**ABSTRACT:** C-reactive protein (CRP) is a protein produced by the liver. CRP levels in the blood, rises when there is an inflammatory condition in the body. A CRP test determines the amount of CRP in the blood to detect inflammation caused by acute conditions or to monitor disease severity in chronic conditions. Covid – 19 is an inflammatory condition, and an increase in CRP level helps in assessing the severity of covid illness. Our aim is to compare the severity of covid illness between the vaccinated and non-vaccinated individuals by estimating the CRP level. This is a cross-sectional study that included 100 Covid positive patients who were clinically diagnosed with fever at Sree Balaji Medical College and Hospital and were randomly selected (both vaccinated and unvaccinated) for the study. The level of serum C-Reactive Protein was estimated in all covid positive patients using the latex agglutination method. Of the 100 covid positive patients, 30 were vaccinated and 70 were not, with 8 vaccinated and 63 non-vaccinated individuals hospitalized due to increased severity. Only 27% of vaccinated people had elevated CRP levels, whereas up to 90% of non-vaccinated people had elevated CRP levels, emphasizing the importance of vaccination in reducing the severity of covid-19 infection. From this study, it was concluded that it is mandatory to estimate CRP level in covid-19 patients as it is an inflammatory marker to assess the severity of the infection in them. Consequently, it is found that vaccines play an important role in reducing the severity of covid infection (as inflammation is reduced)

**Keywords:** Covid-19, C-Reactive Protein, enzyme immunoassay, inflammation, vaccination

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## 1. INTRODUCTION

The coronavirus disease (covid-19), caused by the coronavirus 2 causes severe acute respiratory syndrome, has rapidly evolved into a global pandemic (SARS-CoV-2). The virus was discovered in Wuhan, China, in December 2019. Inhaling contaminated air (via droplets and small airborne particles) spreads it<sup>1</sup>. Coronavirus is a member of the Coronaviridae family, which is known to cause mild respiratory diseases in humans. Severe COVID19 patients are generally treated in the intensive care unit, while mild or non severe patients are treated in the hospital's usual isolation ward. Many people have died in India as a result of Covid-19. The severity of symptoms of Covid-19 varies greatly, ranging from mild (unnoticeable) to severe (life threatening). Symptoms can appear 2-14 days after being exposed to the virus. The virus causes severe lung damage as a result of an overly zealous immune response. This is distinguished by the production of a large number of inflammatory products known as cytokines (also called cytokine storm). This disease begins with mild symptoms and progresses to severe lung pneumonia, which results in hypoxia and death. As a result, it is critical to identify and treat this subset of patients as soon as possible in order to reduce disease severity and improve COVID19 outcomes. The rapid spread of SARS-CoV-2, rapid changes in clinical features, and increased mortality have become the world's top priority. Furthermore, no reliable prognostic indicators exist for predicting disease severity and progression. Recognizing the markers of disease severity may thus greatly aid in the detection of at-risk patients. CRP is an inflammatory marker that is used to assess the severity of an infection (like covid-19). C-reactive protein (CRP) levels can be used to make an early diagnosis of pneumonia<sup>2</sup>, and patients with severe pneumonia had elevated CRP levels. CRP levels in patients with COVID19 increased significantly, with levels ranging from 20 to 50 mg/L on average<sup>3</sup>. CRP levels were found to be elevated in up to 86% of severe COVID19 patients<sup>4</sup>. Some studies have recently reported that C-reactive protein (CRP) levels can be used to aid in the early diagnosis of pneumonia, and that higher CRP levels are associated with severe pneumonia<sup>5</sup>. Patients with severe disease courses had significantly higher CRP levels than mild or nonsevere patients. As a result, the goal of this study was to identify and correlate the significance of CRP in both vaccinated and unvaccinated individuals.

## 2. MATERIALS AND METHODS

This analytical cross-sectional study was conducted in the Department of Biochemistry, Sree Balaji Medical College and Hospital, Chrompet, Chennai during the period of March 2020 – July 2020. The groundwork for the study was started after getting clearance from the research committee and the Institutional human ethics committee (Ethical clearance

number -002/SBMC/IHEC/2021/1623) of Sree Balaji Medical College and Hospital, Chrompet, Chennai. This study included Covid 19 positive patients attending fever clinics at Sree Balaji Medical College and Hospital. They were confirmed by positive RT-PCR test results. A total of 100 patients (30 vaccinated and 70 non vaccinated) were included randomly in the study. Age, gender, height, weight, general history, family history, medications and vitals were recorded. Routine clinical examination was done. The study was explained to the participants and informed consent obtained from them before taking the blood sample. Blood samples were collected from subjects via venepuncture in specific vacutainers under aseptic conditions, and the serum was separated. The serum CRP level was measured by latex agglutination method<sup>6</sup> in all these covid patients.

Group I – 30 vaccinated individuals of 20-50 years with covid 19 infection. 18 male and 12 female patients were included in this study

Group II – 70 Non vaccinated individuals of 20-50 years with covid 19 infection. 46 males and 24 females were included in this study

### 2.1. INCLUSION CRITERIA

RT-PCR positive Covid 19 patients.

### 2.2. EXCLUSION CRITERIA

All the patients with known history of hypothyroidism, vitamin deficiency, haemochromatosis, liver disease, rheumatoid arthritis, and other inflammatory conditions were excluded from the study.

## 3. STATISTICAL ANALYSIS

The characteristics of study participants are summarized using mean and standard deviation. The outcome variables namely, serum CRP level was compared between the two groups using independent t-test. A two sided p-value less than 0.05 was considered to be statistically significant. The analysis was conducted using SPSS version 20.

## 4. RESULTS

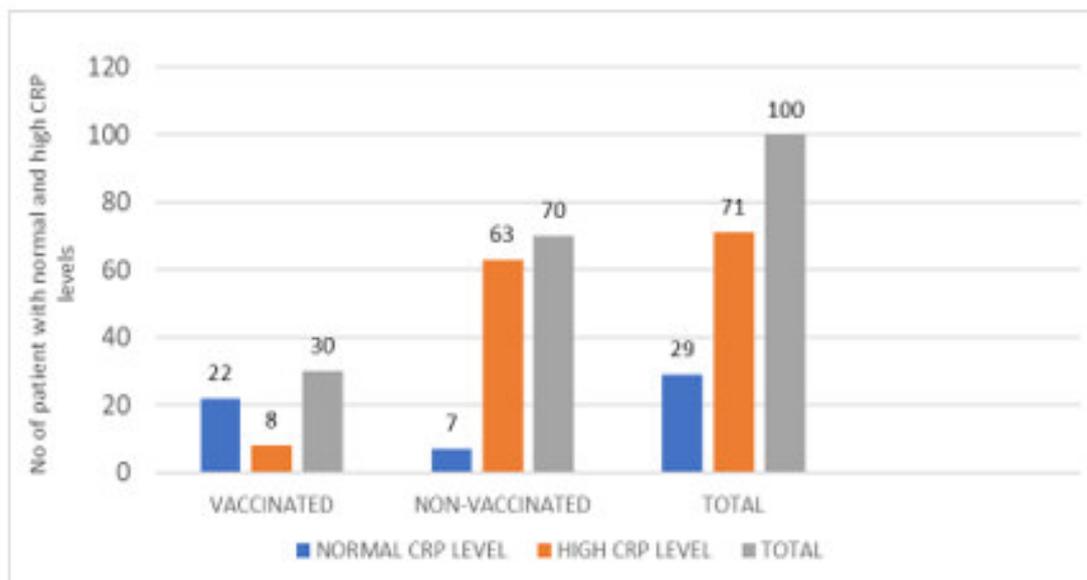
In 100 covid 19 positive patients, 30 were vaccinated and 70 were unvaccinated, with 8 vaccinated and 63 unvaccinated individuals admitted to the hospital. (Majority of the vaccinated individuals affected by covid had less symptoms or had less severity compared to the non-vaccinated individuals affected by covid-19).

PATIENTS	NORMAL CRP LEVELS	HIGH CRP LEVELS	TOTAL
VACCINATED	22	8	30
NON-VACCINATED	7	63	70
TOTAL	29	71	100

Normal CRP level in covid -19 infection is <10mg/L. Of the 30 vaccinated covid patients 22 had normal CRP levels and 8 had high CRP levels of >20mg/dl. And of the 70 unvaccinated covid patients 7 had normal CRP levels and 63 had high CRP levels of >60mg/dl. This shows that unvaccinated covid patients had highly elevated CRP levels.

PARAMETER	GROUP I (mean±SD)	GROUP II (mean±SD)	T value	P value
CRP	4.55	28.64	-11.02	<0.00001

Table – I shows 90% non-vaccinated covid infected patients had increased CRP level which is significant compared to 27% increase in CRP in covid-19 vaccinated individuals with significant p value in student t test in table-2. Unvaccinated covid patients had elevated CRP levels.



**Fig: 1 CRP levels in Vaccinated and unvaccinated individuals**

Figure-I shows 73% of normal CRP, 27% of increased CRP in covid infected vaccinated patients and 10% of normal CRP with 90% of increased CRP in non vaccinated covid infected patients which is significant.

## DISCUSSION

C-reactive protein (CRP) is a pentameric polypeptide that is produced by hepatocytes in response to inflammatory cytokines like IL-6. It is an acute-phase reactant protein that plays a role in a number of inflammatory-mediated disorders. It has the ability to bind to lipoproteins containing apolipoprotein B and opsonize LDL for uptake by human monocyte-derived macrophages<sup>7</sup>. Endothelial cells secrete proinflammatory cytokines (e.g., IL-6, TNF-, adhesion molecules, endothelin-1, and MCP-1)<sup>8</sup>. This raises CRP levels, indicating inflammatory conditions such as covid-19. Overproduction of inflammatory cytokines can result in an increase in CRP levels<sup>10</sup>. Cytokines fight pathogens, but when the system is overactive, it can damage lung tissues<sup>11</sup>. Aside from RT-PCR and CT scan, there are few other tests that can help you track the severity of covid infection and helps to begin treatment as soon as possible<sup>12</sup>. The CRP test is one such test. It is a test that aids in the detection of inflammation or infection in the body. CRP levels are correlated with inflammation levels, and its concentration level is unaffected by factors such as gender, age, and physical condition<sup>13</sup>. In this study, only 27% of vaccinated individuals had elevated CRP levels. Whereas in non-vaccinated individuals the CRP level was elevated up to 90%. Compared to vaccinated individuals, non-vaccinated individuals had high CRP levels. Therefore, there is an increased inflammation seen in non-vaccinated individuals. As vaccinated individuals have less inflammation, and presented with mild symptoms, they did not require hospitalization. Hence, this study shows the importance of covid vaccination and its benefits against covid

infection. In another study by Matsumoto et al., they showed that CRP is an important index for the diagnosis and assessment of severe pulmonary infectious diseases<sup>14</sup>. And also shows the CRP values high in severe pneumonia<sup>15</sup>. This study showed that, as the disease progressed the diameter of the largest lung lesion and CRP levels increased. So, CRP was correlated positively with the disease severity and the lung lesions<sup>16</sup>. This suggests that CRP levels could reflect the disease severity and lung lesions in their early stages of Covid-19.

## 6. CONCLUSION

Covid vaccines help to reduce the severity of infection in people who have been vaccinated against covid-19. Serum CRP levels aid in determining the level of infection or severity in covid patients. As a result, CRP serves as an inflammatory marker. CRP levels are lower in vaccinated individuals compared to non-vaccinated individuals affected by covid-19. According to the findings of this study, it is necessary to estimate CRP levels in covid patients and to get vaccinated against covid infections, because it not only protects individuals from disease, but also reduces their risk of spreading the virus and helps reduce the severity of the infection (symptoms) in the affected individuals.

## 7. AUTHORS CONTRIBUTION STATEMENT

This study was done by Principal investigator, Sample collection and Manuscript writing was done by Dr.K.Sumathi and Miss. B. Manthra. Result analysis and Statistics,

Discussion and Plagiarism check and correction was done by Dr. Shenbaga Lalitha, Dr. Mary Chandrika, and Dr. Chaganti Sridevi.

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## 9. ETHICAL STANDARDS

The study involved human participants following the ethical standards of the tertiary health care institution where the study was conducted.

## 10. LIMITATIONS OF THE STUDY

The study population shall be enlarged as it was relatively less.

## 11. CONFLICT OF INTEREST

Conflict of interest declared none.

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