

# Mild COVID-19 infection-predicting symptomatic phase and outcome: A study from AIIMS, New Delhi

Kirtana J<sup>1</sup>, Arvind Kumar<sup>1</sup>, Swasthi S. Kumar<sup>1</sup>, Anupam K. Singh<sup>2</sup>,  
Sujay Halkur Shankar<sup>1</sup>, Amrit Sharma<sup>3</sup>, Amit Kumar<sup>3</sup>, Ravneet Kaur<sup>4</sup>,  
Maroof A. Khan<sup>5</sup>, Piyush Ranjan<sup>1</sup>, Prayas Sethi<sup>1</sup>, Avinash Chakravarthy<sup>6</sup>,  
Achal K. Srivastava<sup>7</sup>, Naveet Wig<sup>1</sup>

<sup>1</sup>Department of Medicine, All India Institute of Medical Sciences, New Delhi, <sup>2</sup>Department of Medicine, Santosh Medical College, Delhi NCR, <sup>3</sup>Departments of Microbiology, <sup>4</sup>PSM, <sup>5</sup>Biostatistics, <sup>6</sup>Geriatric Medicine, and <sup>7</sup>Neurology, All India Institute of Medical Sciences, New Delhi, India

## ABSTRACT

**Context:** Comprehensive management of mild COVID infection calls for better understanding of symptomatology in these group of patients as well as early identification and close monitoring of patients at risk, data on which is limited. **Aim:** To study association between inflammatory markers and clinical presentation with progression of disease and the duration of resolution of symptoms. **Settings and Design:** This is a retrospective study that has been conducted at a designated COVID -19 medical ward at AIIMS, New Delhi **Methods and Material:** Fifty healthcare workers and their dependents who were admitted with asymptomatic and mild COVID-19 infection were included. Their records were retrospectively reviewed, entered into a predesigned proforma and analyzed. **Results:** A total of 50 participants were included in the study of which 70% were healthcare workers. The patients were admitted with mild COVID illness out of which 22 (44%) were males. Most common symptom at presentation was fever (72%). Among patients who had mild disease versus those who progressed to moderate illness ( $n = 3$ ), the patients with moderate illness were older [mean (SD): 57.33 (10.21) vs. 36.13 (14.05);  $P = 0.014$ ] and had a longer duration of hospital stay [17 (1.41) days vs. 11.20 (3.86) days;  $P = 0.04$ ]. Inflammatory markers, C-Reactive Protein (CRP) [2.46 vs. 0.20 ( $P = 0.024$ )], and Ferritin [306.15 vs. 72.53 ( $P = 0.023$ )] were higher in patients with moderate illness. There is also a significant correlation between the number of days taken for symptoms to resolve with Serum Ferritin ( $P = 0.007$ ), CRP ( $P = 0.0256$ ), and neutrophil lymphocyte ratio (NLR) ( $P = 0.044$ ). **Conclusions:** Acute phase reactants/Inflammatory markers serve as good indicators of time taken to resolution of symptoms in acute COVID infection. NLR is a simple and inexpensive method to provide insight into symptomatic phase. These may be utility tools for primary care physician in the management in periphery and timely decision.

**Keywords:** CRP, ferritin, Mild COVID-19, NLR

## Introduction

At the end of 2019, a novel coronavirus was identified as being responsible for a cluster of pneumonia cases in Wuhan

**Address for correspondence:** Dr. Arvind Kumar,  
Room 3094-A, Third Floor, Teaching Block, All India Institute of  
Medical Sciences, New Delhi - 110029, India.  
E-mail: linktoarvind@gmail.com

Received: 07-08-2020

Revised: 03-09-2020

Accepted: 05-09-2020

Published: 05-10-2020

city, in Hubei province of China. SARS-CoV-2 infection was soon declared a pandemic by the WHO in March 2020 and continues to affect thousands of individuals presenting with a varied clinical profile, disease progression and outcome.

The clinical spectrum of SARS-CoV-2 infection is broad, ranging from asymptomatic infection to flu-like illness (sometimes with digestive disturbances) to viral pneumonia. The median

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow\_reprints@wolterskluwer.com

**How to cite this article:** Kirtana J, Kumar A, Kumar SS, Singh AK, Shankar SH, Sharma A, *et al.* Mild COVID-19 infection-predicting symptomatic phase and outcome: A study from AIIMS, New Delhi. J Family Med Prim Care 2020;9:5360-5.

### Access this article online

#### Quick Response Code:



Website:  
www.jfmpc.com

DOI:  
10.4103/jfmpc.jfmpc\_1610\_20

incubation period, from exposure to symptom onset, is approximately 4–5 days, and 97.5% of symptomatic patients will have symptoms within 11.5 days after infection.<sup>[1]</sup>

Clinically, COVID may be divided into mild, moderate, and severe infections. Moderate infection is defined as a respiratory rate >24/min or a SpO<sub>2</sub> <94% on room air and severe infection as a respiratory rate >30/min or a room air saturation of <90% or respiratory distress requiring mechanical ventilation.<sup>[2]</sup>

Owing to the rapid increase in the number of COVID-19 patients and its varied clinical presentation, there is a need for early identification of signs of deterioration and appropriate escalation of care from isolation wards to specific intensive care units in those patients whose illness progresses rapidly from mild to severe.

Acute phase reactants such as ESR, CRP, Ferritin, Procalcitonin have been reported to be higher in severe as compared to non-severe cases and also as a predictor of mortality in a few cases.<sup>[3]</sup>

## Subjects and Methods

### Study setting

The current study was conducted in a designated COVID ward of a tertiary care academic centre in India. Individuals included were healthcare workers and their direct dependents who had mild symptoms. These patients were admitted after a COVID-19 positive report by an RT-PCR test. In our study, we aimed to identify laboratory parameters and inflammatory markers which may provide an early clue toward duration of symptomatic phase and clinical severity of COVID illness. Ethical clearance was obtained by an appropriate authority. Ethics approval obtained on 22.7.2020.

### Patient characterization & study protocol

The demographic details of the subjects were collected along with available history about the sequence of symptomatology, hospital course, and outcomes. Complete blood counts, liver function tests (including Total Bilirubin, AST, ALT, Total Protein, Albumin, ALP), renal function tests along with CRP, Ferritin, ESR, Procalcitonin reports at admission were traced and collected. Case definitions of severity were as provided by the Ministry of Health and Welfare.<sup>[2]</sup> Patients requiring oxygen support were transferred to a step-up centre within the institute and subsequently followed.

### Statistical analysis

Baseline characteristics of the study participants were summarized. Shapiro–Wilk test of normality was applied to understand the distribution of data. Continuous data was reported as mean (SD) for normally continuous variables or median (Inter Quartile Range -25<sup>th</sup>–75<sup>th</sup> percentile) for skewed distributions. Categorical variables were reported as counts (percentages).

Continuous data in two groups were compared by Welch *t*-test for unequal variance or Wilcoxon test (for non-parametric distribution) depending upon the distribution of data. Association between categorical data was assessed by the Pearson Chi-square test and Fisher's exact test. Correlation between two continuous variables was performed using Pearson's correlation or Spearman's rank correlation test (for non-parametric distribution) depending upon the normality of bivariate joint distribution. *P* value of less than 0.05 was considered statistically significant at a 95% confidence level.

Clinically important risk factors and variables related to the dependent outcome (Time to Symptom Resolution, which is described as duration of first day of symptom to last day of symptom related to acute COVID infection) were included in multivariable regression analysis. A value of *P* < 0.05 was considered statistically significant in the multivariate analysis. All statistical analysis was done using R software version 3.5.2.

## Results

In the study, 50 patients were enrolled. 70% of these were healthcare workers and 30% were their direct dependents (spouse/parents/children). The mean age of these patients was 37.40 years (SD 14.68). The demographic characteristics of these patients are given in Table 1. Other minor comorbidities included hypothyroidism, paroxysmal supraventricular tachycardia, and hypercholesterolemia.

Clinical manifestations and significant contact history if any are mentioned in Table 2. 43 individuals (86%) were symptomatic at presentation. COVID-19 testing and subsequent admission was done after a median duration of 3 (2, 5) days of symptom onset. Time to Resolution (TTR) of symptoms was skewed due to a longer duration of illness in some of the individuals (1–27 days). 50% of patients presented with fatigue as their first symptom even before developing fever. Wilcoxon test showed that healthcare workers (*P* = 0.009), older individuals (*P* < 0.001), and those in contact with a confirmed COVID-positive patient (*P* = 0.01) were more likely to be symptomatic. Duration of hospital stay is the number of days an individual was kept in an isolation ward as an inpatient.

**Table 1: Baseline Demographic Characteristics and Comorbidities**

| Characteristic                    | n=50   | n (%)     |
|-----------------------------------|--------|-----------|
| Sex                               | Male   | 22 (44.0) |
|                                   | Female | 28 (56.0) |
| Healthcare Workers                |        | 35 (70.0) |
| Comorbidities                     |        |           |
| Diabetes mellitus                 |        | 5 (10.0)  |
| Hypertension                      |        | 5 (10.0)  |
| Respiratory Illness (COPD/Asthma) |        | 3 (6.0)   |
| Heart Disease (CAD)               |        | 1 (2.0)   |
| Other                             |        | 3 (6.0)   |

The mean duration of hospital stay was  $11.48 \pm 3.97$  days. The median TTR of symptomatic phase of was 7 days. Three individuals progressed to Moderate illness and were shifted to a step-up COVID facility within the institution.

Laboratory parameters have been mentioned in Table 3. Other parameters not included in this table such as the renal function and liver function parameters along with electrolytes were reported normal in all individuals.

### Relationship between variables

A Wilcoxon test showed a statistically significant association between serum ferritin levels and duration of hospital stay ( $P = 0.012$ ). There is also a significant correlation (Pearson's correlation coefficient) between TTR with Serum Ferritin ( $P = 0.0007$ ), CRP ( $P = 0.026$ ), and NLR ( $P = 0.044$ ). Correlation Matrix of Selected inflammatory Variables with Time to Resolution is presented in Figure 1.

**Table 2: Baseline Clinical presentation and Course**

| Symptom                                  | n (%)                        |
|------------------------------------------|------------------------------|
| Fever                                    | 36 (72.0)                    |
| Cough                                    | 20 (40.0)                    |
| Sore Throat                              | 19 (38.0)                    |
| Chills                                   | 13 (26.0)                    |
| Myalgia                                  | 12 (24.0)                    |
| Fatigue                                  | 10 (20.0)                    |
| Shortness of Breath                      | 6 (12.0)                     |
| Diarrhoea                                | 6 (12.0)                     |
| Rhinitis                                 | 4 (8.0)                      |
| Contact History                          |                              |
| Contact with a confirmed case of COVID19 | 28 (56.0)                    |
| Healthcare Worker at a COVID area        | 3 (6.0)                      |
| Healthcare Worker at a Non-COVID area    | 32 (64.0)                    |
| Residing at or Visited a Hotspot         | 1 (2.0)                      |
| Travel History (%)                       | 3 (6.0)                      |
| Treatment and Outcome                    |                              |
| Hydroxychloroquine                       | 37 (75.5)                    |
| Oxygen requirement                       | 3 (6.0)                      |
| Outcome                                  |                              |
| Discharged                               | 47 (94)                      |
| Transferred                              | 3 (6)                        |
| Time to Resolution of Covid symptoms     | 7 [2.00-9.50] (Median [IQR]) |

**Table 3: Baseline Laboratory Profile**

| Lab Parameter                          | Median [IQR]         |
|----------------------------------------|----------------------|
| ESR (mm/hr)                            | 22 [14.25,31.50]     |
| CRP (mg/dl)                            | 0.22 [0.07,051]      |
| Procalcitonin. (ng/ml)                 | 0.02 [0.01,0.03]     |
| Ferritin (ng/ml)                       | 74.26 [27.59,141.90] |
| Haemoglobin (g/dl)                     | 12.90 [12.28, 14.55] |
| Total Leukocyte Count (cells/cumm)     | 5420 [4620, 6557]    |
| Neutrophils (%)                        | 52.50 [47.95, 61.65] |
| Lymphocytes. (%)                       | 34.10 [27.15, 40.70] |
| Platelets. ( $\times 10^3$ cells/cumm) | 194 [153, 240]       |
| Neutrophil- Lymphocyte ratio           | 1.56 [1.19, 2.26]    |

A linear model was used to predict the duration of resolution with CRP, Ferritin, NLR, ALT, Age, Sex, and Fever. Our final regression equation was predicted TTR (days) =  $1.95 - 0.44 \times \text{CRP} + 0.17 \times \text{NLR} + 0.02 \times \text{Ferritin} + 0.03 \times \text{ALT} - 0.01 \times \text{Age} + 0.31 \times \text{Sex} + 2.07 \times \text{Fever}$

The combination of these parameters significantly predicted the duration of TTR. There were 29 observations in our model (excluding missing data in all variables). The number of predictors in the model was 7, while the degree of freedom of residuals was 21. In statistical notation this is expressed as  $F(7, 21) = 2.49, P = 0.049$ . The standard deviation of residual error was 4.7 implying duration of resolution was predicted with an average accuracy of  $\pm 4.7$  days by our model. The adjusted R-Square for our model is 0.27 implying our model predicts 27.16% variation in the duration of resolution.

### Multivariable linear regression

On Univariate Regression CRP, NLR, and Ferritin were significantly correlated with TTR, but on multivariable regression, adjusting for other variables, only level of Ferritin had significant relationship with TTR.

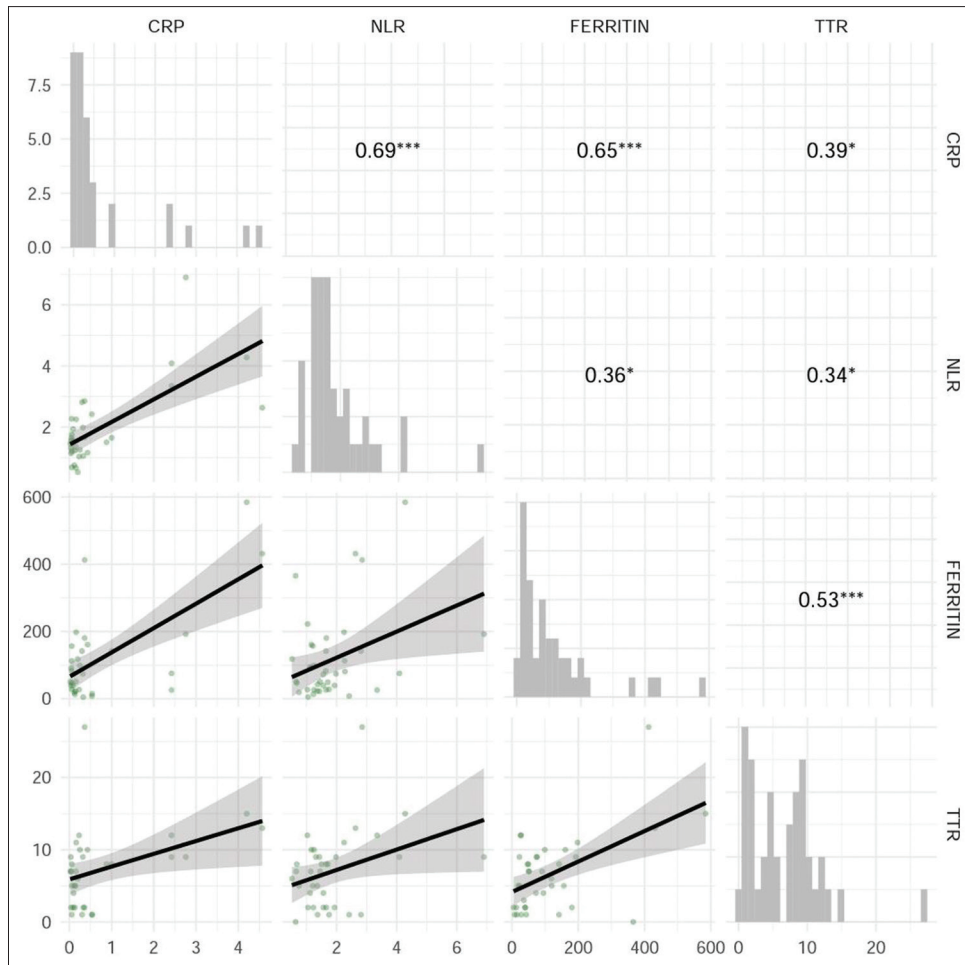
The effect of Ferritin was positive and can be considered as medium and significant ( $\beta = 0.02, 95\% \text{ CI } [0.01, 0.05]$ , std.  $\beta = 0.62, P = 0.048$ ) as shown in Figure 2. Out of all variables, ferritin [ $\beta = 0.025 - 0.01$ ] had highest standardized regression coefficient and contributed maximum to predicted TTR (in days). Details of univariable and multivariable regression are presented in Table 4.

### Comparative analysis according to severity

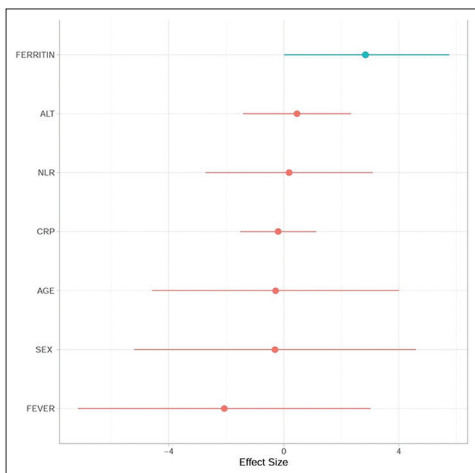
Subgroup analysis between the patients who had mild disease versus those who progressed to moderate illness ( $n = 3$ ) showed that those with moderate illness were older in age [mean (SD): 57.33 (10.21) vs. 36.13 (14.05);  $P = 0.014$ ] and also had a longer duration of hospital stay [17 (1.41) days vs. 11.20 (3.86) days;  $P = 0.04$ ] Other hematological parameters, liver, and kidney function tests were comparable among the two groups. Individuals who went on to have moderate illness also showed higher values of inflammatory markers CRP, Ferritin, ESR, Procalcitonin, and NLR, although only CRP and Ferritin elevations were statistically significant [Table 5]. There was a discordance in the number of healthcare workers posted in non-COVID areas as compared to designated COVID Wards and ICUs who had tested positive.

## Discussion

This study was done to ascertain the clinical presentation and correlation of routine lab parameter and inflammatory markers with course of the illness in mild COVID infection. In this study, the most common symptoms at presentation were fever (72%), cough (40%), sore throat (38%), myalgia (24%), and fatigue (20%).



**Figure 1:** A multi-panel plot showing relationship between time to resolution of symptoms (TTR) and inflammatory markers (CRP, ferritin), and NLR (Neutrophil-lymphocyte ratio). Lower triangle of matrix consists of scatter plot and regression line depicting relationship between two variables in corresponding rows and columns. In mid-panel, histograms denote distribution of data points in the variables. Upper triangle of panel matrix denotes correlation co-efficient between the two variables. (\* $p < 0.05$ , \*\*\* $p < 0.001$ )



**Figure 2:** Forest Plot of Effect Size of Independent Variables in Multivariable Regression

Our study found that while most individuals recovered without any complications, some did progress to moderate illness, and inflammatory markers such as Ferritin and C-reactive Protein

predicted this progression. Although procalcitonin, ESR levels and the NLR ratio were higher in the moderate group it was not statistically significant. In addition, Ferritin, C-Reactive Protein, and the NLR were also predictive of the TTR of symptoms in these individuals.

Ferritin and CRP levels done at admission for our patients were significantly higher in those who progressed to moderate disease. Those individuals who had only asymptomatic or mild disease had normal values of these biomarkers. In a meta-analysis done by Zeng *et al.* which included 16 studies showed that patients in the non-severe group as compared to those in the severe groups had lower CRP, ESR, Procalcitonin, and serum ferritin levels.<sup>[3]</sup> Another meta-analysis published by Zhang *et al.* which included 4662 individuals reported that the most common laboratory findings were increased CRP (73.6%), decreased albumin (62.9%), increased ESR (61.2%), decreased Eosinophils (58.4%), increased IL-6 (53.1%), lymphopenia (47.9%), and increased LDH (46.2%).<sup>[4]</sup> Although our study reported similar findings, there was no variation in leukocyte count or the differential count as such. Also, the studies mentioned above and similar studies



**Table 4: Summary of Multivariable linear regression analysis of Factors Predicting Time To Symptom Resolution**

| Variables | Range        | Mean (SD) | Coefficient (univariable)      | Coefficient (multivariable)    |
|-----------|--------------|-----------|--------------------------------|--------------------------------|
| Age*      | [23,75]      | 6.5 (5.1) | 0.08 (-0.06-0.21, $P=0.243$ )  | -0.01 (-0.22-0.20, $P=0.892$ ) |
| Ferritin  | [5.1,584]    | 6.6 (5.3) | 0.02 (0.01-0.03, $P=0.001$ )   | 0.02 (0.01-0.05, $P=0.048$ )   |
| NLR       | [0.52,6.9]   | 7.0 (5.2) | 1.42 (0.04-2.79, $P=0.044$ )   | 0.17 (-2.53-2.88, $P=0.896$ )  |
| CRP       | [0.025,4.57] | 7.2 (5.4) | 1.77 (0.23-3.31, $P=0.026$ )   | -0.44 (-3.44-2.55, $P=0.762$ ) |
| Sex*      | Male         | 7.4 (6.3) | -                              | -                              |
|           | Female       | 5.9 (4.1) | -1.44 (-4.71-1.84, $P=0.381$ ) | 0.31 (-4.59-5.21, $P=0.897$ )  |
| Fever     | No           | 3.8 (3.8) | -                              | -                              |
|           | Yes          | 7.0 (5.2) | 3.14 (-1.36-7.64, $P=0.167$ )  | 2.07 (-3.02-7.16, $P=0.407$ )  |
| ALT       | [12,163]     | 6.5 (5.2) | 0.04 (-0.01-0.09, $P=0.143$ )  | 0.03 (-0.09-0.15, $P=0.614$ )  |

\*Adjusted for Age and Sex

**Table 5: Comparison between Mild and Moderate Illness**

| Marker           | Mild Illness<br>(n=47) [Median]<br>[IQR] | Moderate Illness<br>(n=3) [Median]<br>[IQR] | P     |
|------------------|------------------------------------------|---------------------------------------------|-------|
| CRP              | 0.18 [0.06,0.45]                         | 2.46 [1.41,3.51]                            | 0.024 |
| Ferritin         | 72.53 [27.10,120.00]                     | 306.15 [243.42,368.88]                      | 0.023 |
| ESR              | 20.00 [12.75,30.00]                      | 37.5 [33.75,41.25]                          | 0.385 |
| Procalcitonin    | 0.02 [0.010,0.025]                       | 0.04 [0.025,0.055]                          | 0.984 |
| Neutrophil       | 1.47 [1.15,2.04]                         | 2.63 [2.14,2.87]                            | 0.349 |
| Lymphocyte Ratio |                                          |                                             |       |

focused on those individuals who were critically ill with severe COVID-19 infection contrary to our setting where we looked for progression in those who presented with mild infection only. These biomarkers may prove to be useful for the primary care physician especially for monitoring those individuals who cannot get admitted.

The exact mechanism behind increase in Serum Ferritin is still unknown but is postulated to be either due to promotion of ferritin synthesis by activated inflammatory cytokines such as IL-6 or leakage of intracellular ferritin secondary to inflammation related cellular damage.<sup>[5]</sup> Ferritin levels are significantly higher in non-survivors when compared to survivors. With clinical improvement, levels of ferritin have been seen to decrease, making it a good parameter to assess severity and response to treatment.<sup>[6]</sup>

Although not statistically significant, our study showed a higher value of the neutrophil-lymphocyte ratio in those who progressed to moderate illness. The NLR is calculated by dividing the absolute neutrophil count by the absolute lymphocyte count. A study done by Liu *et al.* concluded NLR is an independent risk factor of in-hospital mortality for COVID-19 patients.<sup>[7]</sup> Another meta-analysis done by Lagunas Ranguel *et al.* on the association of NLR and severe COVID infection showed that NLR values were significantly higher (SMD = 2.404, 95% CI = 0.98–3.8 2).<sup>[8]</sup> A study done by Yang *et al.* reported values of NLR > 3.3 showing a possibility of progression to severe disease.<sup>[9]</sup> It is a cost-effective and simple method to assess the severity of illness and may provide an insight into disease progression and outcome in resource-limited settings.

A significant and new finding of our study included the association of TTR of symptoms with the inflammatory markers measured at the time of admission. Ferritin ( $P = 0.0007$ ), CRP ( $P = 0.026$ ), and the NLR ( $P = 0.044$ ) were elevated in those patients in whom symptom resolution took a longer time duration, in either case of mild or moderate. The discharge policy for inpatients with COVID-19 in India has been evolving and this may help in predicting the turnover time of admissions at a centre and help optimal uses of resources. At present, as per policy, patients are discharged on 10<sup>th</sup> day of first symptom or 3 days of asymptomatic phase whichever is longer. Hydroxychloroquine was administered at doses of 400 mg BD on the first day followed by once a day for 4 days in 75.5% individuals. No adverse events were reported with its use in our study. Efficacy cannot be commented upon in this particular study.

The limitations of this study include its retrospective design which made the study prone to missing data. The smaller sample size and inclusion of only mild cases makes this study prone to bias. The evolution of management of mild COVID has seen many discrete phases starting from mandatory indoor care for all patient, to recently permitting home isolation and observation. These policies are justified as we moved from containment to mitigation during the course of the pandemic, and may get further modified with time. These developments make these kinds of studies more relevant for family and primary care physicians when milder COVID-19 cases will be managed either in home isolation or COVID care facility under supervision, and hospital beds might be difficult to get in current epidemic and in near future.

This study has shown similar results with respect to increased levels of inflammatory markers like Ferritin and CRP predicting progression of disease from mild to moderate illness. In addition, Serum Ferritin, C-Reactive protein Levels and NLR also had significant statistical correlation with duration to complete symptom resolution of these individuals and can be used as markers to monitor patients at home or hospital care, and counselling for the same to allay the anxiety. Further studies serial values of these markers along with follow through the course of the illness will provide a broad overview in this attempted correlation.

## Messages

Ferritin and CRP are markers of disease progression in COVID-19 infection. Ferritin, NLR and CRP are predictors of duration to symptom resolution in COVID-19 infection.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR, *et al.* The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: Estimation and application. *Ann Intern Med* 2020;172:577-82.
2. Ministry of Health and Family Welfare; Govt of India: Clinical Management Protocol: COVID 19 updated version dt. 2020 July 3. Available from: <https://www.mohfw.gov.in/pdf/UpdatedClinicalManagementProtocolforCOVID19dated03072020.pdf>.
3. Zeng F, Huang Y, Guo Y, Yin M, Chen X, Xiao L, *et al.* Association of inflammatory markers with the severity of COVID-19: A meta-analysis. *Int J Infect Dis* 2020;96:467-74.
4. Zhang ZL, Hou YL, Li DT, Li FZ. Laboratory findings of COVID-19: A systematic review and meta-analysis. *Scand J Clin Lab Invest* 2020;1-7. doi: 10.1080/00365513.2020.1768587.
5. Lin Z, Long F, Yang Y, Chen X, Xu L, Yang M. Serum ferritin as an independent risk factor for severity in COVID-19 patients. *J Infect* 2020;S0163-4453 (20) 30434-5. doi: 10.1016/j.jinf.2020.06.053.
6. Gómez-Pastora J, Weigand M, Kim J, Wu X, Strayer J, Palmer AF, *et al.* Hyperferritinemia in critically ill COVID-19 patients—Is ferritin the product of inflammation or a pathogenic mediator? *Clin Chim Acta* 2020;509:249-51.
7. Liu Y, Du X, Chen J, Jin Y, Peng L, Wang HH, *et al.* Neutrophil-to-lymphocyte ratio as an independent risk factor for mortality in hospitalized patients with COVID-19. *J Infect* 2020;81:e6-12.
8. Lagunas-Rangel FA. Neutrophil-to-lymphocyte ratio and lymphocyte-to-C-reactive protein ratio in patients with severe coronavirus disease 2019 (COVID-19): A meta-analysis. *J Med Virol* 2020. doi: 10.1002/jmv. 25819
9. Yang AP, Liu J, Tao W, Li HM. The diagnostic and predictive role of NLR, d-NLR and PLR in COVID-19 patients. *Int Immunopharmacol* 2020;84:106504.