Analysis of Haematological Parameters Correlates with the Physiological Variables among Mild COVID-19 Patients Admitted in the Tertiary Care Hospital of Pune District

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i36A31935

Editor(s): (1) Dr. Rahul S. Khupse, University of Findlay, USA. (2) Dr. Francisco Cruz-Sosa, Metropolitan Autonomous University, México. (3) Dr. Syed A. A. Rizvi, Nova Southeastern University, USA.

Reviewers: (1) Hans Agarwal, Dayalbagh Educational Institute, India. (2) Md. Sadique Shaikh, AIMSR, India. (3) Andrés Joaquín Guarnizo Chávez, Universidad de Cuenca, Ecuador.

Complete Peer review History: http://www.sdiarticle4.com/review-history/69516

ABSTRACT

Background: The COVID-19 pandemic has put global health at stake by creating havoc all over the world, due to which the world, as well as health agencies, are experiencing the greatest challenges of all times. This disease is a health emergency due to its high level of infectiousness and due to the non-availability of any specific treatment. COVID 19 is a health emergency due to its high infectiousness, as currently, there is no treatment available.

Objectives: To determine the significance of physiological and haematological parameters in the diagnosis of COVID 19 infection and compare these parameters according to comorbid conditions during the disease progression among mild COVID 19 patients.

Methodology: This retrospective, observational study was carried out in a designated tertiary care hospital...
1. INTRODUCTION

The COVID-19 pandemic has put global health at stake by creating havoc all over the world, due to which the world, as well as health agencies, are experiencing the greatest challenges of all times. COVID 19 can be a health-related crisis due to its speedy community transmission and also due to the non-availability of any specific treatment [1]. Hubei province of China has reported many pneumonia cases of unknown aetiology around December 2019 [2]. Various strains of the corona, which are known till now, like MERS and SARS-CoV, can cause systemic infection among different animals like bats, pigs, camels, etc. This can lead to infections related to the respiratory tract of various grades among humans [3]. New coronavirus (COVID-19) has a high case fatality rate among critically ill patients. Ever since India's first case was diagnosed on Jan 30, 2020, there are around 12,00,000 cases, around 30,000 deaths have occurred due to this novel virus. A large number of Indian cases have been reported from the state of Maharashtra, which accounts for just over a third of the country's cases [4] that are nearly 3,60,000 and 12,000 deaths.

Literature from other countries such as Italy, Spain, France, and the United States has suggested high mortality associated with this disease and overburdening intensive care units [5]. Transmission of the disease usually occurs among the closed contact family members and also among the hospital staff members [6]. Most of the patients exhibited mild symptoms, and partially few patients exhibit a worse prognosis [7]. Patients usually have a wide range of symptoms depending on the severity of the illness, maximum patients who are infected with this novel infection don't have any symptoms; certain clinical manifestations may appear around the first 14 days of virus exposure and includes fever and or without chills, headache, cough, difficulty in breathing or shortness of breath, easy fatigability, body aches or muscular pain [8]. New symptoms may vary from loss of smell and taste sensation, running nose and congestion, diarrhoea, nausea, vomiting [9]. In India, around 80% of the Covid-19 patients either have mild symptoms, or most of them are asymptomatic [10]. Most of them (about 96% approximately) recover from the disease without needing special treatment in India. The vulnerable population includes old aged (>55 years), and those who have underlying comorbid medical conditions like diabetes, hypertension, chronic kidney diseases, respiratory disorders like bronchial asthma are more prone to develop severe symptoms due to COVID 19 [11]. As the disease transmission rate is very fast, there is a need for continuous improvement and advancement in its clinical diagnosis and treatment, and also there is a need to do extensive research for understanding the disease progression as well as the expected treatment modalities [12]. It is also necessary to explore various biochemical and physiological parameters that are still in the exploratory stage and can help understand the prognosis of the disease. Suppose any disease progression in the body is to be understood. In that case, one should know that it's the severe inflammatory responses that contribute heavily to the weak acquired immune response of the host that can lead to the immune system imbalance. Inflammation can occur due to various infectious diseases and can mark as an important predictor of the disease progression. Thus, circulating biomarkers are representatives of inflammatory and immune system responses and are also potential predictors for understanding the prognosis and the disease progression among COVID-19 patients [13]. Total leukocyte count (TLC), (NLR) neutrophil to lymphocyte ratio, lymphocyte-to-monocyte ratio (LMR), and (PLR) platelet to lymphocyte ratio are frontline predictors used in the prognosis of any viral infection and also the related response to inflammation. The liver secretes CRP (C-reactive protein) as a response to various inflammatory

Results: Out of the total study participants, 112 were male, and 90 were females with an average age of (43.43±15.07) and (51.8±16.35) respectively.

Conclusion: Study of physiological and haematological parameters and their interrelation will help in understanding the impact of COVID 19 infection on the reactive inflammatory responses and will help in understanding the prognosis of the disease.

Keywords: COVID 19, co-morbid; diabetes mellitus; haematological; physiological.
cytokines. The CRP level increases rapidly with a response to infection, inflammation, and trauma and reduces rapidly as the underlying condition resolves. Thus, CRP levels are widely used to monitor various inflammatory disorders [14]. The present study analysis will help in defining laboratory results and clinical characteristics among mild COVID patients, which will improve the precision and will also help in elucidating the risk factors associated with mortality and will also help to determine the significance and correlation of physiological variables with haematological parameters with the length of hospital stay among patients with mild symptoms of COVID-19 [15].

1.1 Aim

To determine the significance of physiological and haematological parameters in the diagnosis of COVID 19 infection and also to compare these parameters in accordance with comorbid conditions during the disease progression among mild COVID 19 patients.

1.2 Objectives

- To analyse the haematological (Inflammatory markers), parameters, physiological variables among mild COVID 19 patients.
- To correlate the haematological findings and physiological variables with the comorbid conditions of the patient.
- To analyse the relationship of Inter variable analysis of physiological and haematological parameters during the course of hospital stay.

2. MATERIALS AND METHODS

2.1 Study Design

This retrospective, observational study was carried out in a designated tertiary care hospital for the admission of COVID19 patients in the Pune district. The random purposive sampling technique was used based on the duration of the study (1 month), based on which recruitment of 202 patients was done for the present study. Positive patients were randomly selected based on the RT-PCR lab reports either on nasal or pharyngeal swab specimens, pertaining to the standard guidelines provided by the world health organization (WHO).

2.2 Inclusion Criteria

- Lab confirmed cases of COVID 19 (with mild symptoms as per standard guidelines prescribed by WHO)
- Patients with Age>18 years

2.3 Exclusion Criteria

- Patients with Age <18 years
- Confirmed patients of COVID 19 (with moderate and severe symptoms)
- Patients with haematological diseases, chronic kidney, lung, and liver disease
- Patients undergoing radiotherapy and chemotherapy were excluded from the present study.

3. METHODOLOGY

3.1 Clinical Characteristics and Laboratory Data

A detailed patient profile screening was done based on the records, which include recent exposure history, clinical signs and symptoms, and association of any comorbid conditions. Various parameters were obtained for Analysis which includes.

3.1.1 Physiological variables

Temperature, pulse, blood pressure, respiratory rate was obtained from the records of the patients.

3.1.2 Haematological parameters

TLC, NLR, LMR, PLR, CRP, ANC, ALC, AMC, PL values were obtained from electronic medical records. The patient's complete blood count was done on a fully automated five-part haematology analyser: Beck man Coulter DXH 800, and peripheral blood smear examination were performed under a microscope. Records for all the parameters were obtained for day one and day ten of the admission. Neutrophil lymphocyte ratio (NLR), Lymphocyte monocyte ratio (LMR), and Platelet lymphocyte ratio (PLR) were subsequently derived using standard formulae. CRP test was performed by a quantitative method, which is based on the principle of Nephelometry. (MISPA-AGAPE Diagnostics limited, Kerala, India). Serum samples were analysed for the same on the day of admission and repeated on day 10. CRP test was
considered positive if the value was >6mg/L and negative if the value was <6mg/L.

### 3.1.3 Statistical Analysis

Grouping of the patients was done based on Age, Sex, BMI, and also based on comorbidities. Study variables were expressed as means and standard deviations. Descriptive and inter variable Analysis was performed to assess parametric variations during the disease progression using one-way ANOVA analysis; values ≤0.05 were considered statistically significant. Pearson's correlation coefficient was obtained to determine the correlation between haematological parameters level of significance was set between 0.5 to 1.0 and values in this range were considered statistically significant.

### 4. RESULTS

Out of the total study participants (n=202), 112 were male, and 90 were females. The Average Age of the study subjects ranged (43.43±15.07) in males and (51.8±16.35) in females, respectively. The average BMI was 25.48±3.85, in males it was 24.37±3.55, and in females, it was 25.44±3.99, surprisingly the BMI in diabetic patients and hypertensive patients was 29.23±4.13 and 25.57±4.37 respectively. Out of 202 subjects, n=58 were hypertensive, n=54 were diabetic patients and hypertensive patients was 29.23±4.13 and 25.57±4.37 respectively. Out of 202 subjects, n=58 were hypertensive, n=54 were diabetic, and n=29 were diabetic and hypertensive. Fig. 1 shows the Gender distribution. Fig. 2 shows the Hypertensive patients. Fig. 3 shows Patients suffering from diabetes mellitus. Fig. 4 shows Patients suffering. Fig. 5 shows the Patients having diabetes and hypertension. Fig. 6 shows Gender-based variation among diabetes patients. Fig. 7 shows the distribution of patients and according to the BMI. Significant variations were found in the physiological and haematological variables among the entire population compared with the day of admission. Fig. 8 shows the distribution of the study population based on BMI. Very highly significant variations were found in the physiological variables like Pulse 0.0037, SBP, DBP (0.0000), RR (0.0009), as well haematological parameters, like CRP, TLC, PCT, ANC, AMC, NLR, PLR, LMR (0.0000), when compared with the day of admission among the entire population, except for ALC (0.7400). Table 1 Significant variations were seen in pulse 0.173 SBP, DBP, RR, CRP, TLC, PCT, ANC, AMC, NLR, PLR, LMR (0.0000), (ALC 0.6400) among male (n=112) subjects, and Pulse (0.0066), SBP, DBP, CRP, TLC, PCT, ANC, NLR, PLR, LMR (0.0000), AMC (0.0022), LMR (0.0041) showed significant variation among female patients (n=90) (except RR which surprisingly did not show any significant variation (0.6770) in Table 2. Significant variation in DBP was found among male (0.0047) and female (0.0050) diabetic patients and for TLC, PCT, NLR, and PLR (0.0000) among both male and female diabetic patients. A highly significant variation was seen for ALC among female diabetic patients (0.0009) and for ANC among male diabetic patients (0.0001) in Table 3. Significant variation was seen in the heart rate (0.0980) and platelet count (PCT) (0.0950) among hypertensive subjects in Table 4. Pearson's correlation coefficient showed a significant correlation among physiological and haematological variables when compared with gender, and comorbid conditions like diabetes and hypertension, especially physiological parameters like SBP and DBP (0.72, 0.73 respectively) were significantly correlated with gender while haematological parameters were significantly correlated with comorbid conditions like diabetes mellitus TLC (0.92), PCT (0.80), NLR (0.95) PLR (0.93) shown in Table 5.

**Fig. 1. Gender distribution**
Fig. 2. Hypertensive patients

Fig. 3. Patients suffering from diabetes mellitus

Fig. 4. Patients suffering

Fig. 5. Patients having diabetes and hypertension
Fig. 6. Gender-based variation among diabetes patients

Fig. 7. Distribution of patients and according to the BMI

Fig. 8. Distribution of study population based on BMI
Table 1. Distribution of study population based on Analysis of study variables for the entire population

| Physiological variables | Characteristics | Day 1 (n=202) | Day 10 (n=202) | P-value |
|-------------------------|----------------|--------------|----------------|---------|
| Pulse                   | 74.59 ± 5.24   | 75.16 ± 4.87 | 0.0037*        |
| SBP                     | 126.92±11.15   | 126.83±10.64 | 0.0000***      |
| DBP                     | 76.82±5.76     | 76.02±5.32   | 0.0000***      |
| RR                      | 21.96±2.00     | 16.63±2.00   | 0.0009***      |
| CRP                     | 33.26±40.60    | 21.20±28.53  | 0.0000***      |
| TLC                     | 5.78±2.19      | 6.76±2.16    | 0.0000***      |
| PCT                     | 249.70±82.65   | 302.89±103.62| 0.0000***      |
| ANC                     | 3.38±1.65      | 3.77±1.71    | 0.0000***      |
| ALC                     | 1.78±0.69      | 3.32±10.32   | 0.7400         |
| AMC                     | 0.56±0.25      | 0.59±0.31    | 0.0000***      |
| AMC                     | 2.42±3.08      | 2.21±2.39    | 0.0000***      |
| PLR                     | 164.41±86.63   | 163.24±112.92| 0.0000***      |
| LMR                     | 3.44±1.39      | 4.42±2.04    | 0.0000***      |

Abbreviations: SBP- systolic blood pressure, DBP- diastolic blood pressure, RR- respiratory rate, CRP- C-reactive protein, TLC- total leucocyte count, PCT- platelet, ANC- absolute neutrophil count, ALC- absolute lymphocyte count, AMC- absolute monocyte count, NLR- neutrophil to lymphocyte ratio, PLR- platelet to lymphocyte ratio, LMR- lymphocyte to monocyte ratio

The average BMI was 25.48±3.85. In males, it was 24.37±3.55, and in females, it was 25.44±3.99. Out of 202 subjects, n=58 was hypertensive, n=54 were diabetics, and n=28 was diabetic and hypertensive. Analysis of variables for both are Very highly significant variations were found in the physiological variables, Pulse 0.0037, SBP, DBP (0.0000), RR (0.0009), as well haematological parameters, CRP, TLC, PCT ANC, AMC, NLR, PLR, LMR (0.0000), as compared to with the day of admission among the entire population. Significant variations were seen in pulse 0.173 SBP, DBP, RR, TLC, PCT, ANC, AMC, NLR, PLR, LMR (0.0000), (ALC 0.6400) among male (n=112) subjects, and Pulse (0.0066), SBP, DBP, CRP, TLC, PCT, ANC, AMC, NLR, PLR, LMR (0.0000), (ALC 0.0022), LMR (0.0041) showed significant variation among female patients (n=90). Significant variation in DBP was found among male (0.0047) and female (0.0050) diabetic patients and for TLC, PCT, NLR, and PLR (0.0000) among both male and female patients. A highly significant variation was seen for ALC among female diabetic patients (0.0009) and for ANC among male diabetic patients (0.0001). Significant variation was seen in the heart rate (0.0980) and platelet count (PCT) (0.0950) among hypertensive subjects. There was a significant correlation among physiological and haematological variables when compared with gender and comorbid conditions like diabetes and hypertension, especially physiological parameters like SBP and DBP (0.72, 0.73 respectively). Haematological parameters were significantly correlated with comorbid conditions like diabetes mellitus TLC (0.92), PCT (0.80), NLR (0.95) PLR (0.93).

5. DISCUSSION

While the COVID 19 pandemic is entirely sweeping around the entire world, it is really a prime concern to understand the process of transmission of the disease as well as to study the major adverse effects which occur in the body and also to analyse which has made it to convert into a global pandemic. COVID 19 is a novel type of virus that belongs to the family of coronavirus, which includes the MERS (Middle East Respiratory Symptoms) as well as SARS (Severe Acute Respiratory Syndrome) and virus [16]. The most affected organ due to COVID 19 is the lung, and also it causes damage to the immune system of the body. The majority of the patients will not show any symptoms in the initial stage of the disease, and if present too, 80% will exhibit mild symptoms, around 14% of patients do suffer pneumonia, and 5% may land up in a septic shock leading respiratory failure and death [17]. This novel infectious disease exhibits around 3 to 4 % of case fatality rate too. Some of the primary symptoms of COVID 19 infected patients are mild to the severe grade of fever with or without chills, giddiness, feeling of breathlessness, headache, and also dry cough; few novel types of symptoms include loss in smell and taste sensation, few severe category patients, have also reported of diarrhoea and easy fatigability. 80% of the patients will show no
symptoms or have mild symptoms, 14% of the infected patients may develop pneumonia, 5% of the patients will develop a septic shock and land up in multi-organ failure (mostly respiratory failure) and considering these complications, the overall case fatality rate remains between 3 to 4%. The major aim of the study was to analyse the physiological and haematological parameters among mild COVID 19 patients and to understand if these parameters are going to get affected due to disease progression. Our study showed a significant correlation of physiological as well as haematological parameters when compared with gender and also when compared with comorbid conditions like diabetes mellitus and hypertension. Our study results showed significant relevance of the clinical characteristics with the previous literature. We tried to assess immunological characteristics of COVID-19 patients using haematological parameters. Our study takes account of the inflammatory processes in disease prognosis, where we tried to analyse the values of not only NLR, PLR, ratios as compared with the previous studies, but also the levels of ANC, AMC, ALC, PCT, TLC, and the ratio of LMR too, as these parameters are nowadays increasingly preferred to be investigated in the current COVID 19 scenarios. Our hypothesis is based on the fact that the human immune responses, which are notoriously triggered due to the viral load or infection, mainly rely on the support system of the lymphocytes; on the other hand, the cellular immune responses are suppressed due to systemic inflammatory responses leading to decrease in levels of T lymphocytes and CD4+ cells and increased levels of the suppressor T lymphocyte or CD8+. The inflammation triggered by the virus will lead to elevated NLR levels, which will lead to COVID-19 progression. Lymphocytes are first-line markers to produce the immune response in the patients, while the destructive inflammatory response is a result of the neutrophil's response. These ratios try to work as a reflection of acute inflammatory responses (increase in neutrophils and platelets) and acute physiological stress (decrease in lymphocyte), which leads to an increase in the heart rate and respiratory rate. In the present study, our results helped us to prove our hypothesis. They indicated that elevated NLR, PLR, and LMR ratios could be utilized as an independent prognostic biomarker to assess the prognosis in these patients. Besides, the integration of elevated neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), lymphocyte to monocyte ratio (LMR), and physiological variables like pulse and blood pressure in the nomograms of prognosis will lead to improved prediction of morbidity as well as morality. Our findings of the significant correlation of NLR ratio with gender and comorbid conditions are under the previous literature. Neutrophils, most abundant among the leukocyte pool, get activated and migrate to the immune system from the venous drainage system that helps in releasing the virus from cells due to DNA damage and the release of a large number of reactive oxygen species. In addition to these changes, neutrophils try to produce a large number of cytokines and the effectors. Most of the patient's exhibit mild or no symptoms, and few exhibits a worse prognosis. Molecules with the help of interaction with the perceptible cell population this may cause the destruction of the virus directly by antibody-dependent cell-mediated cell (ADCC), which will lead to exposure of the antigen of the virus and also stimulation of various immune responses. Not limited to this function, neutrophils perform the same function of production of cytokines and effectors molecules like VEGF, which in turn can stimulate the growth, setting metastasis and tumour angiogenesis. VEGF-A and VEGF-C, when compared with other tissues, tend to possess a significantly high level of activity or expression among patients suffering from COVID 19. In the conditions where the expressions of VEGF and VEGFR are limited or reduced, there is less tissue as well as damage to the organs. Furthermore, the neutrophil response is usually triggered due to inflammatory factors related to the virus, which includes granulocyte colony-stimulating factor, interferon-gamma factors interleukin-6, alpha tumour necrosis factor, which are usually produced by the endothelial cells and the lymphocytes. C reactive protein (CRP), a widely accepted marker to annotate the acute-phase inflammatory response, is often correlated with inflammation. Its concentration is never affected by factors like age, sex, and physical condition. Our results showed the significant contribution of CRP levels in the assessment of the disease progression, especially among the patients with comorbid conditions like diabetes mellitus, based on the fact that elevated CRP levels tend to activate the complement system, and Pearson's correlation coefficient was obtained to determine the correlation between haematological and physiological parameters; the level of significance for r values was set between 0.5 to1.0 and values in this range were considered statistically significant.
Table 2. Analysis of study variables based on variations with respect to gender

| Physiological variables | Day 1 (n=202) | Day 10 (n=202) | P value |
|-------------------------|---------------|----------------|---------|
|                         | Male n=112    | Female n=90    |         |
|                         | Male n=112    | Female n=90    |         |
| Pulse                   | 74.03 ± 5.06  | 75.28 ± 5.39   | 0.1730**|
| SBP                     | 126.46 ± 9.79 | 127.48±12.67   | 0.0000***|
| DBP                     | 76.10 ± 5.32  | 77.71±6.17     | 0.0000***|
| RR                      | 22.01±2.10    | 21.88±1.87     | 0.0000***|
| CRP                     | 28.54±39.21   | 39.14±41.75    | 0.0000***|
| TLC                     | 5.50±1.75     | 6.13±2.60      | 0.0000***|
| PCT                     | 243.39±79.45  | 257.55±86.28   | 0.0000***|
| ANC                     | 3.10±1.32     | 3.73±1.95      | 0.0000***|
| ALC                     | 1.69±0.65     | 1.89±0.73      | 0.6400**|
| AMC                     | 0.58±0.25     | 0.53±0.25      | 0.0000***|
| AMC                     | 0.58±0.25     | 0.53±0.25      | 0.0000***|
| NLR                     | 2.25±2.54     | 2.64±3.64      | 0.0000***|
| PLR                     | 165.77±86.07  | 162.73±87.77   | 0.0000***|
| LMR                     | 3.17±1.27     | 3.78±1.45      | 0.0000***|

| Haematological parameters | Day 1 (n=202) | Day 10 (n=202) | P value |
|----------------------------|---------------|----------------|---------|
|                            | Male n=112    | Female n=90    |         |
|                            | Male n=112    | Female n=90    |         |
| P value                    | Male n=112    | Female n=90    |         |

Note: P values ≤0.05 were considered statistically significant.
### Table 3. Analysis of study variables based on variations with respect to diabetes mellitus

| Physiologic variables | Characteristics | Day 1 Male | Day 1 Female | Day 10 Male | Day 10 Female | P value Male | P value Female |
|-----------------------|----------------|------------|-------------|-------------|--------------|-----------|-------------|
|                       |                | n=30       | n=24        | n=30        | n=24         |           |             |
| Pulse                 |                | 78.51±4.75 | 73.16±4.65  | 77.62±4.28  | 74.26±4.77   | 0.1670    | 0.1080      |
| SBP                   |                | 134.62±7.48 | 124.10±10.95 | 132.03±8.95 | 124.93±11.03 | 0.3090    | 0.9700      |
| DBP                   |                | 79.11±4.67  | 75.98±5.90  | 78.11±4.45  | 75.27±5.43   | 0.0047**  | 0.0050**    |
| RR                    |                | 21.94±1.89  | 21.96±2.04  | 17.27±2.62  | 19.36±2.00   | 0.1670    | 0.1080      |
| **Haematological parameters** | CRP             | 52.49±37.46 | 5.74±30.65  | 36.17±41.79 | 25.57±25.48  | 0.0197    | 0.1870      |
|                       | TLC            | 6.06±1.95   | 5.94±2.67   | 6.62±1.76   | 6.47±2.40    | 0.0000***  | 0.0000***   |
|                       | PCT            | 217.70±58.79 | 270.33±90.78 | 287.33±87.84 | 322.03±97.53 | 0.0003***  | 0.0000***   |
|                       | ANC            | 3.54±1.62   | 3.84±1.86   | 3.22±0.93   | 4.40±1.96    | 0.0421    | 0.0009***   |
|                       | ALC            | 1.74±0.73   | 1.87±0.64   | 2.25±0.76   | 2.56±0.71    | 0.0001***  | 0.0332      |
|                       | AMC            | 0.72±0.31   | 0.60±0.16   | 0.64±0.22   | 0.67±0.25    | 0.0000***  | 0.0865      |
|                       | NLR            | 3.15±4.96   | 3.77±6.01   | 3.73±3.08   | 3.49±3.39    | 0.0000***  | 0.0000***   |
|                       | PLR            | 156.75±109.75 | 183.77±117.15 | 206.34±147.77 | 210.39±181.75 | 0.0000***  | 0.0000***   |
|                       | LMR            | 2.69±1.13   | 3.83±1.50   | 3.38±1.30   | 4.46±1.99    | 0.0068    | 0.2220      |
| Physiological variables | Characteristics | Day 1 (n=58)       | Day 10 (n=58)     | P-value |
|-------------------------|-----------------|--------------------|-------------------|---------|
| Pulse                   |                 | 75.43 ± 5.55       | 76.09 ± 5.24      | 0.0980**|
| SBP                     |                 | 127.12±11.24       | 126.87±10.64      | 0.9730  |
| DBP                     |                 | 76.14±4.63         | 75.81±4.60        | 0.7310  |
| RR                      |                 | 21.96±1.81         | 16.70±1.81        | 0.7600  |
| Haematological parameters |                |                    |                   |         |
| CRP                     |                 | 35.32±39.09        | 23.70±33.32       | 0.4480  |
| TLC                     |                 | 6.06±1.89          | 6.94.1.94         | 0.4510  |
| PCT                     |                 | 241.47±74.73       | 282.18±85.65      | 0.0950**|
| ANC                     |                 | 3.44±1.48          | 3.57±1.53         | 0.2900  |
| ALC                     |                 | 1.88±0.76          | 2.47±0.85         | 0.4790  |
| AMC                     |                 | 0.60±0.27          | 0.62±0.29         | 0.5600  |
| NLR                     |                 | 3.32±5.51          | 2.59±3.61         | 0.1660  |
| PLR                     |                 | 168.55±110.39      | 174.13±168.57     | 0.4000  |
| LMR                     |                 | 3.28±1.32          | 4.66±2.04         | 0.3120  |

Abbreviations: SBP- systolic blood pressure, DBP- diastolic blood pressure, RR- respiratory rate, CRP- C-reactive protein, TLC- total leukocyte count, PCT- platelet, ANC- absolute neutrophil count, ALC- absolute lymphocyte count, AMC- absolute monocyte count, NLR- neutrophil to lymphocyte ratio, PLR- platelet to lymphocyte ratio, LMR- lymphocyte to monocyte ratio.
Table 5. Analysis of correlation of physiological and haematological variables for all the study population based on gender and comorbid conditions

| Physiological variables | Characteristics | Entire Population (202) | Male (112) | Female (90) | Patient with diabetes (n=54) | Non-Diabetic patients (148) | Diabetic Males | Non-Diabetic Males | Diabetic Females | Non-Diabetic Females |
|-------------------------|-----------------|------------------------|------------|-------------|-----------------------------|---------------------------|----------------|-------------------|-----------------|--------------------|
| RR                      |                 | 0.23                   | 0.36       | 0.04 ns     | 0.01 ns                     | 0.37                      | 0.29           | 0.40              | -0.29 ns        | 0.35               |
| Pulse                   |                 | 0.20                   | 0.12 ns    | 0.28        | -0.06 ns                    | 0.20 ns                   | 0.02 ns        | 0.20              | -0.06 ns        | 0.01 ns            |
| SBP                     |                 | 0.72**                 | 0.68**     | 0.77**      | 0.52**                      | 0.72**                    | 0.56**         | 0.66**           | 0.50**          | 0.82**             |
| DBP                     |                 | 0.73**                 | 0.69**     | 0.74**      | 0.62**                      | 0.73**                    | 0.72**         | 0.68**           | 0.59**          | 0.78**             |
| Haematological parameters |                 |                        |            |             |                             |                           |                |                   |                 |                    |
| CRP                     |                 | 0.64**                 | 0.69**     | 0.66**      | 0.38                        | 0.74**                    | 0.47           | 0.69**           | 0.24 ns         | 0.80**             |
| TLC                     |                 | 0.71**                 | 0.71**     | 0.71**      | 0.92**                      | 0.64**                    | 0.86**         | 0.70**           | 0.95**          | 0.59**             |
| PL                      |                 | 0.67                   | 0.72**     | 0.61**      | 0.80**                      | 0.65**                    | 0.67**         | 0.73**           | 0.86**          | 0.45               |
| ANC                     |                 | 0.55**                 | 0.52**     | 0.54**      | 0.51**                      | 0.58**                    | 0.42           | 0.60**           | 0.58**          | 0.53**             |
| ALC                     |                 | -0.02 ns               | -0.04 ns   | 0.53**      | 0.52**                      | -0.04 ns                  | 0.69**         | -0.06 ns         | 0.39            | 0.61**             |
| AMC                     |                 | 0.31                   | 0.33       | 0.31        | 0.37                        | 0.31                      | 0.72**         | 0.33             | 0.32            | 0.33               |
| NLR                     |                 | 0.80**                 | 0.88**     | 0.77**      | 0.95**                      | 0.41                      | 0.99**         | 0.50**           | 0.93**          | 0.43               |
| PLR                     |                 | 0.76**                 | 0.71**     | 0.81**      | 0.93**                      | 0.61**                    | 0.94**         | 0.64**           | 0.94**          | 0.56**             |
| LMR                     |                 | 0.42                   | 0.55**     | 0.30        | 0.40                        | 0.43                      | 0.54**         | 0.54**           | 0.23            | 0.34               |

Abbreviations: SBP- systolic blood pressure, DBP- diastolic blood pressure, RR- respiratory rate, CRP- C-reactive protein, TLC- total leukocyte count, PCT- platelet, ANC- absolute neutrophil count, ALC- absolute lymphocyte count, AMC- absolute monocyte count, NLR- neutrophil to lymphocyte ratio, PLR- platelet to lymphocyte ratio, LMR- lymphocyte to monocyte ratio. It can lead to phagocytises, ultimately clearing off the microorganisms from the body.
6. CONCLUSION

The present study will help in understanding the impact of COVID 19 infection on the reactive inflammatory responses. It will help in understanding the prognosis of the disease based on the estimation of various physiological and haematological parameters proving their significant role in understanding the disease progression. Levels of NLR, PLR, LMR, CRP, heart rate, respiratory rate can work as an independent prognostic biomarker and dependent physiological variable among COVID 19 patients. Although the concentration of this widely accepted marker for the acute-phase inflammatory response is often correlated with the level of inflammation, it is unaffected by factors such as age, sex, or physical condition. Based on the fact that elevated CRP levels tend to activate the complement system and Pearson’s correlation coefficient was obtained to determine the correlation between haematological and physiological parameters, our findings showed a significant contribution of CRP levels in assessing disease progression, especially among patients with comorbid conditions like diabetes mellitus.

7. LIMITATIONS

The present study involves mild COVID 19 patients; it would have been more interesting to see if the levels of these parameters were obtained among moderate and severe COVID 19 patients. Ours is an observational study that shows or proves the temporal correlation ship between the exposure and the outcome. In contrast, the demographical and prospective epidemiological study would have been more beneficial in providing accurate levels of inflammatory mediators.

CONSENT

After obtaining prior informed consent, the retrospective data were collected from the admitted patients’ medical records.

ETHICAL APPROVAL

Ethical clearance taken from Symbiosis Medical College for Women, Symbiosis International (Deemed University), Pune, Maharashtra, India.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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