Evaluation of Biochemical Parameters in Positive COVID-19 RealTime PCR Results Patients

Abstract

Coronavirus, a member of the beta coronavirus family, encompasses a range of illnesses from common colds to severe disorders. SARS-CoV-2, transmitted mainly through respiratory droplets, caused the global pandemic COVID-19 in 2020. The virus primarily targets the respiratory system, leading to diverse symptoms and severe consequences. This study was carried out in the COVID-19 Isolation Centre in Mukalla City, Yemen, to evaluate biochemical tests in COVID-19 patients**.** In the retrospective single-centre study on 116 COVID-19 patients, Analysed Parameters were glucose, Liver function tests, renal function tests, lipid profile, and proinflammatory markers; convenience sampling based on existing records for socio-demographics, medical history, and biochemistry were analysed by using a spectrophotometry and Chemiluminescent immunoassay analyser. We used SPSS version 25 to analyse data. Most COVID-19 patients in Mukalla City (91.4 % of those over 46 years old) have common symptoms such as fever, cough, and respiratory problems. The study found links between chronic health disorders (hypertension 96.6 %, diabetes mellitus 94.8 %) and greater vulnerability to COVID-19. Blood glucose levels substantially impact COVID-19 occurrences (p 0.0001). Some liver function tests are associated with COVID-19 (total protein, albumin, LDH, and GGT) (p = 0.044, 0.010, 0.0001, and 0.0001, respectively). Urea and creatinine levels imply renal function and their significant association (p=0.001 for both), whereas uric acid had no significant association with COVID-19 (p = 0.134). However, lipid profile tests lack statistical significance; they do identify trends. Proinflammatory markers CRP and ferritin strongly correlate with positive COVID-19 patients (p=0.0001 for both). In conclusion, COVID-19 significantly affects glucose metabolism, liver function, renal dynamics, and inflammatory markers, necessitating vigilant monitoring for clinical care and informing future research.

Keywords: Coronavirus, SARS-CoV-2, RT. PCR Biochemical Tests, Mukalla City, Yemen.

1.Introductions

Coronavirus, a member of the beta coronavirus family, is an enclosed single-stranded RNA virus that causes illnesses ranging from common colds to life-threatening disorders. Common colds are often caused by several subtypes easily transmitted among humans(Q. Li et al., 2020). Several coronaviruses originating in animals can cause severe illnesses in humans via zoonotic transmission. SARS coronavirus-2 (SARS-CoV-2) is transmitted from person to person and spreads via respiratory droplets and contaminated surfaces(Akdogan, Guzel, Tosun, & Akpinar, 2021; Azman & Luquero, 2020). COVID-19, triggered by SARS-CoV-2, became a worldwide pandemic in March 2020 (Alfadda et al., 2021; Nizami, Raman, Paulose, Hazari, & Mallick, 2021)Recent reports mention anosmia, ageusia, fever, cough, headache, and nausea. While 80% have moderate symptoms, the remaining 20 % risk a rapid development to severe consequences, such as respiratory distress and multiple organ failure, with a mortality rate of more than 50 %. SARS-CoV-2 predominantly targets the respiratory system, entering cells via the angiotensin-converting enzyme-2 receptor, causing initial lung injury and unleashing a harmful cytokine storm, resulting in severe symptoms and sequelae(Bulut & Kato, 2020; Gautier & Ravussin, 2020; Kumar, Singh, Mohanty, Bahurupi, & Gupta, 2021; Wang, Tang, & Wei, 2020). COVID-19 spreads fast throughout the Middle East, with Iran serving as the epicenter. WHO reported 423,437,674 confirmed cases and 5,878,328 deaths (Dhabaan, Chahin, Buhaish, & Shorman, 2020). Yemen reported its first verified case on April 10, 2020, in Hadhramaut. Globally, as of February 20, 2022, there were 11,736 confirmed cases and approximately 2,122 deaths, with Hadhramaut reporting 4,270 confirmed cases and around 1,082 deaths, according to the Supreme National Emergency Committee for Coronavirus COVID-19 (Edrees, Abdullah, Al-Shehari, Alrahabi, & Khardesh, 2024). Biochemical analysis shows significant ALT, D-dimer, creatinine, and blood urea increases observed in COVID-19 ICU patients(Z. Li et al., 2020; Parlakpinar & Gunata, 2021). High D-dimer levels were linked to severe symptoms and death. Some patients had elevated ALT, AST, creatinine, and creatine phosphokinase levels(Deng et al., 2020; Håglin, Törnkvist, & Bäckman, 2014; Wu et al., 2020) Considerable research has been devoted to the clinical dimensions of COVID-19; however, the precise biochemical alterations linked to the disease remain poorly understood, particularly in Mukalla City, Yemen. Prior research has identified higher levels of blood urea, ALT, D-dimer, and creatinine as indicators of severe cases; however, there is a shortage of comprehensive evaluation of these indicators.

This study aims to fill this void by making a focused inquiry into the biochemical changes identified in individuals in Mukalla City who have contracted COVID-19, taking into account regional discrepancies and demographic attributes. It is of the utmost importance to comprehend the correlation between these markers and the evolution of the disease to design diagnostic and therapeutic approaches that are successful and specific to the local environment. By concentrating on Mukalla City, this study seeks to provide significant contributions to understanding COVID-19-related aspects such as severity, prognosis, and treatment monitoring. By doing so, it hopes to fill a gap in current research and contribute to developing region-specific disease management in future.

2-Materials and Methods

2.1. Study design, area, and populations

A retrospective analytical study investigation focused on probable COVID-19 adult Yemeni patients who tested positive at the isolation center of COVID-19 at Mukalla city, and exclusion criteria included those with severe comorbidities and those under the age of 18. The sample size 116 was selected with a confidence level of 95% and a precision of 10% to assess biochemical markers in COVID-19 patients who contracted the infection between January 1, 2022, and October 1, 2022.

2.2. Data collection and sampling methods

Data were collected from existing records using the convenience sampling method. These data included the socio-demographics of participants (age, gender, and social status), Patient medical history (clinical symptoms, vital signs, and chronic diseases), and biochemistry analysis that included of Random blood glucose, CRP, liver enzymes (AST, ALT, LDH, and GGT) and lipid profiles (triglyceride, total cholesterol, high-density lipoprotein-cholesterol "HDL-C" and low-density lipoprotein-cholesterol "LDL-C") and renal function test (urea, creatinine, uric acid) were measured using of spectrophotometric (Cobas Integra 400 plus analysers, Roche Diagnostics GmbH, Mannheim, Germany) and Chemiluminescent immunoassay (Cobas e 411 analyser, Roche Diagnostics GmbA, Mannheim, Germany) for measurement of Serum ferritin.

2.3. Statistical Analysis

For this data analysis, we consulted SPSS version 25. The distributions by frequency and percentage of the category variables were shown. The mean and standard deviation were employed for continuous average data, while the median (interquartile range) was employed for continuous non-normal variables. A chi-square test showed a link between COVID-19 and high-risk factors, while an independent sample-T test compared the two study groups. Statistical significance was established with a *p-value* less than 0.05 at a 95% confidence level.

3. Results

The average age of the people tested with RT-PCR was 63.5 years old, and the standard deviation was 14.5 years. Those aged 46 and over make up 91.4% of the test population, while those aged 45 and under account for 8.6%. The gender breakdown is 60.3% men and 39.7% women. All of the people who were tested are married, according to the social status analysis; there is not a single person among them. The demographic makeup of people with positive RT-PCR results can be better understood with the help of this detailed sociodemographic as show in **Figure (1).**

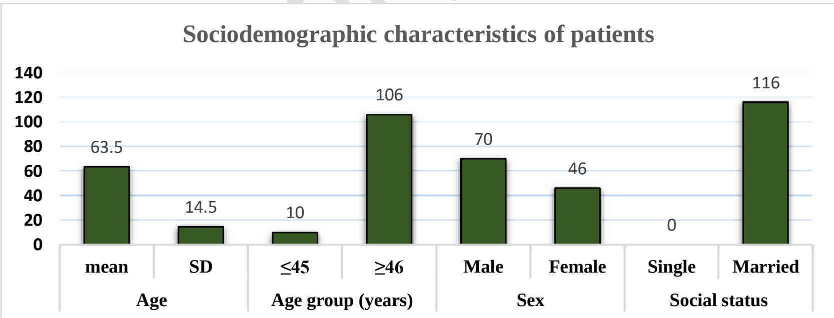

Figure (1) Sociodemographic characteristics of patients.

Clinical symptoms found in patients with a positive COVID-19 RT-PCR test shows a high incidence of common symptoms. All subjects (n=116) reported having a fever, cough, sore throat, and trouble breathing, demonstrating that these symptoms were present in all positive cases. Joint and muscle aches were reported by a large majority of people, accounting for 96.6 %(n=112) of the total. Furthermore, nausea, vomiting, and diarrhoea were present in 98.3 % (n=114) of the cases. Chills were reported by 10.3 % (n=12) of the people, while pneumonia was reported by 6.9 % (n=8). This comprehensive review highlights the continuous occurrence of characteristic COVID-19 symptoms in those with positive RT-PCR results as shown in **Figure (2).**

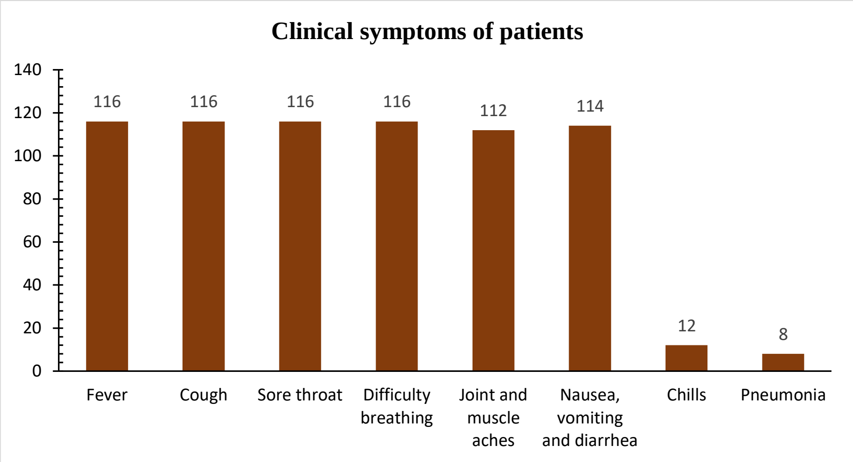

Figure (2) Clinical symptoms of patients

According to the favourable RT-PCR data, COVID-19 seems to have a disproportionate impact on people who already have chronic health problems. Results show that hypertension is quite common among the study's subjects; in fact, 96.6% (n=112) of those who tested positive for RT-PCR also reported having a family history of the disease. In a similar vein, 94.8% (n=110) of the positive individuals had diabetes mellitus, further demonstrating the link between the two conditions and vulnerability to COVID-19. Additionally, only 6.9% of persons (n=8) with a history of lung disease tested positive for COVID-19. Although the prevalence of lung disease was lower than that of hypertension and diabetes, it is nevertheless an essential factor that increases vulnerability. The overall 96.6% (n=112) of the participants suffering from a chronic condition, the total prevalence of chronic diseases among those with positive RT-PCR results is enormous. Further supports the correlation between chronic conditions and an elevated risk of developing COVID-19. It is essential to understand these relationships to assess risk, implement preventative measures, and provide tailored interventions for persons with underlying health concerns as shown in **Figure (3).**

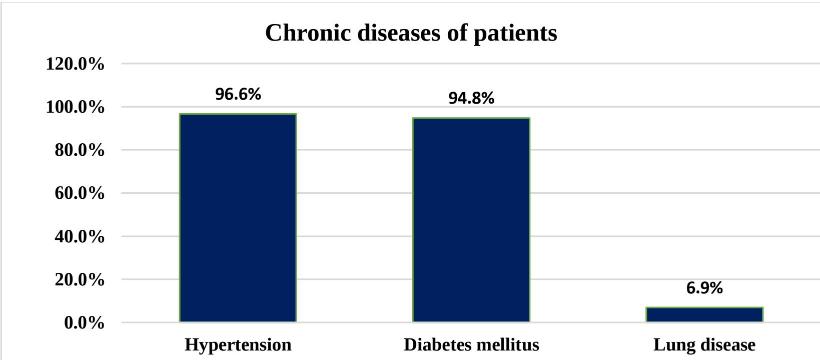

Figure (3) Shows the chronic diseases of patients

Results show that COVID-19 patients are likelier to have elevated random blood glucose (RBG) values. Among the patients, 67 mg/dl was the median RBG level, with values ranging from 191-259 mg/dl in the interquartile range. A p-value of less than 0.001 indicates that this link is statistically significant. The findings highlight the importance of blood glucose levels in comprehending and treating COVID-19 instances as shown in **Table (1).**

Table (1). Association between the random blood glucose and COVID-19 Patients

Parameter	Positive RT-PCR Patients	P-value
RBG (mg/dl)	67 (191-259)	<0.001

Data are expressed interquartile range. Independent sample-T test was used to compare between two groups. P <0.05 considered as a significant value. The analysis was done at 95% confidence interval. RBG: random blood glucose

The study suggests a possible link between these bilirubin levels and COVID-19 patients. Total bilirubin (0.056), direct bilirubin (0.045), and indirect bilirubin (0.023) have p-values that are near to significant. Total protein levels have a p-value of 0.044, indicating a statistically significant link with COVID-19 patients. Albumin levels are linked to COVID-19 patients, and the p-value (0.010) indicates statistical significance. Although the p-values for AST (0.086) and ALT (0.077) are not statistically significant, AST and ALT levels reveal a potential relationship with COVID-19 patients. LDH and GGT levels are significantly linked to COVID-19 patients. Both LDH and GGT had p-values less than 0.001, indicating statistical significance as shown in **Table (2).**

Table (2) Association between the liver function test and COVID-19.

Parameter	Minimum	Maximum	Mean	P-value
Bilirubin total (mg/dl)	0.4	1.8	0.7	0.056
Bilirubin Direct (mg/dl)	0.1	1.3	0.4	0.045
Bilirubin indirect (mg/dl)	0.3	1	0.6	0.023
Total protein (g/dl)	3.3	6.1	4.4	0.044
Albumin (g/dl)	2.8	4.6	3.5	0.101
AST (U/L)	24	42	25	0.086
ALT (U/L)	22	44	19	0.077
LDH (U/L)	320	512	191	0.001
GGT (U/L)	32	72	17	0.001

Data are expressed interquartile range. Independent sample-T test was used to compare between two groups. P <0.05 considered as a significant value. The analysis was done at 95% confidence interval.
AST: aspartate aminotransferase; ALT: alanine aminotransferase; LDH: lactate dehydrogenase; GGT: gamma-glutamyl transferase.

There is a statistically significant difference between a reference group and COVID-19-positive patients, with a median urea concentration of 34 mg/dL (range from 17 to 102) (P-value: 0.001). These results about the effects of COVID-19 on kidney function. Like how COVID-19-positive patients had a range of 0.5 to 3.2 mg/dL, the median creatinine concentration is 1.0 mg/dl Monitoring creatinine levels in COVID-19 cases is crucial since the related P-value of 0.001 shows a statistically significant difference compared to a reference group. Highlights the considerable impact on renal function. COVID-19-positive patients had a median uric acid concentration of 4.4 mg/dL (range from 4.0 to 5.4), and a P-value of 0.134 indicated no statistically significant difference. Notwithstanding this, changes in renal function in COVID-19 instances may still be uncovered by monitoring uric acid levels as shown in **Table (3).**

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Table (3) Association between the renal function test and COVID-19.

Parameter	Minimum	Maximum	Mean	P-value
Urea (mg/dL)	30	150	50	0.03
Creatinine (mg/dL)	0.8	1.8	1.2	0.12
Uric acid (mg/dL)	2.5	8	4	0.001

Data are expressed interquartile range. Independent sample-T test was used to compare between two groups. P <0.05 considered as a significant value. The analysis was done at confidence interval 95%

The study examined the association between lipid profile tests and COVID-19 patients, focusing on critical parameters. HDL-C levels in positive RT-PCR cases had a median of 10 mg/dL (interquartile range: 28-38 mg/dL), but the was no statistically significant association (p = 0.142). Similarly, LDL-C levels had a median of 35 mg/dL (108-144 mg/dL), with no significant association (p = 0.476). Total cholesterol levels were 44 mg/dL on average (interquartile range: 142-186 mg/dL), and the link was not statistically significant (p = 0.858). Triglyceride readings did not exhibit a trend, with a median of 50 mg/dL and an interquartile range of 117-168 mg/dL. The investigation into the link between lipid profile tests and COVID-19 patients focused on critical aspects. Although the link was not statistically significant (p = 0.142), the median HDL-C level in positive RT-PCR cases was 10 mg/dL (interquartile range: 28-38 mg/dL). LDL-C values varied from 108 to 144 mg/dL, with no

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statistically significant connection ($p = 0.476$). There is a statistically significant relationship ($p = 0.225$). So, the p-values supplied show no statistically significant relationship between these lipid profile characteristics and positive RT-PCR results for COVID-19 as shown in **Table (4).**

Table (4) Association between the lipid profile tests and COVID-19 Patients

Parameter	Minimum	Maximum	Mean	P-value
HDL-C (mg/dL)	28	38	30	0.142
LDL-C (mg/dL)	108	144	35	0.476
Total cholesterol (mg/dL)	142	186	44	0.858
Triglyceride (mg/dL)	117	168	50	0.225

Data are expressed interquartile range. Independent sample-T test was used to compare between two groups. P <0.05 considered as a significant value. The analysis was done at 95% confidence interval.
HDL-C: high-density lipoprotein-cholesterol; LDL-C: low density lipoprotein-cholesterol.

We looked at essential characteristics to determine whether there was a correlation between COVID-19 patients and proinflammatory indicators. A highly significant correlation ($p < 0.001$) was revealed by C-reactive protein (CRP) levels, which in persons with positive RT-PCR results had a median value of 50 mg/L (interquartile range: 73-123 mg/L). The ferritin levels among COVID-19 patients were also significantly associated with the virus, with a median value of 818 ug/L (interquartile range: 872-1691 ug/L) and a p-value of less than 0.001. The results show a robust and statistically significant correlation between high ferritin and CRP levels and positive COVID-19 RT-PCR results as shown **Table (5),**

Table (5) Association between the proinflammatory markers and COVID-19 Patients.

Parameter	**Positive RT-PCR**	**P-value**
CRP (mg/L)	50 (73-123)	<0.001
Ferritin (ug/L)	818 (872-1691)	<0.001

Data are expressed interquartile range. Independent sample-T test was used to compare between two groups. P <0.05 considered as a significant value. The analysis was done at 95% confidence interval.
CRP: C-Reactive proteins

4. Discussion

This study at the COVID-19 Isolation Center in Mukalla City, Yemen, utilized real-time PCR to confirm SARS-CoV-2 infection. Its goal was to systematically assess biochemical tests in COVID-19 patients, as biochemical analysis provides valuable insights into the disease's physiological changes, severity, prognosis, diagnosis, and treatment monitoring.

The median value of Random Blood Glucose (RBG) readings among COVID-19-positive patients was 67 mg/dL, ranging from 191 to 259. When compared to relevant studies in the field, the observed P-value of less than 0.001 indicates a statistically significant difference; this shows that patients infected with COVID-19 may have altered glucose metabolism, which warrants further examination; this finding aligns with studies conducted by (Chai et al., 2022; Xiao et al., 2022) they found similar differences in RBG levels in COVID-19 patients. The same pattern throughout these trials emphasizes the importance of monitoring glucose metabolism as part of the clinical profile in people infected with the virus.

The liver function test results in COVID-19 patients provide insight into potential correlations between biochemical markers and viral infection. The findings are discussed in a prior study on liver function in COVID-19 patients. Bilirubin Levels: The investigation found a modest increase in total bilirubin (0.7 mg/dl, p=0.056), with direct bilirubin within the normal range (0.4 mg/dl, p=0.045) and indirect bilirubin (0.3 mg/dl, p=0.023). Compared to the previous study (Xie et al., 2020), Investigations have confirmed that this change indicates the dynamic nature of liver function during COVID-19 infection (Li et al., 2003; Vítek, Novotný, Sperl, Holaj, & Spácil, 2006) because bilirubin has anti-inflammatory properties and is a significant antifibrogenic agent via heme oxygenase-1. Indirect bilirubin may help to reduce oxidative stress, inflammation, and the advancement of liver fibrosis (Zhang et al., 2020).

Elevated total protein (6.6 g/dl, p=0.044) and normal albumin (3.5 g/dl, p=0.010) levels indicate aberrant protein metabolism. When these findings are compared to the prior study, it is clear that liver dysfunction affects protein indicators. For instance, a study shows that most severe COVID-19 patients had a low albumin level, demonstrating a link between liver function and C-reactive protein, an inflammation marker (Wei et al., 2020). Another study found that decreasing albumin levels in severe patients implies liver injury. These findings support the theory that COVID-19 can impact protein metabolism and liver function, resulting in changes in protein indicators (Luo, Zhang, & Xu, 2020). Furthermore, the abnormal protein markers observed in COVID-19 patients with liver involvement may reflect the systemic impact of the virus. Studies have shown that COVID-19 can induce inflammation and affect various organ systems, including the liver, demonstrating a positive correlation between systemic inflammation levels and radiographic characteristics in COVID-19 patients (L. Chen et al., 2020). The levels of AST and ALT are normal (22 U/L and 18 U/L, respectively) with non-significant p-values (0.086 and 0.077). However, the levels of LDH and GGT are much lower (0.001). This variation in liver enzyme profiles could point to a unique hepatic response to COVID-19. A comparison to the prior research in one study, they discovered that ALT and AST levels were higher in COVID-19 patients and that the AST/ALT ratio was a significant prognostic predictor(Liu et al., 2020). Another study found higher levels of GGT in COVID-19 participants(Henry et al., 2020). However, it is crucial to remember that liver enzyme profiles can change between patient cohorts and can be influenced by various factors such as age, gender, comorbidities, and disease severity. As a result, a direct comparison with past studies may not show whether these differences are typical or unique to the current group. More specific research is needed to understand better COVID-19's hepatic reaction and its implications for patient outcomes.

Results show substantial changes in urea and creatinine concentrations between a control group and COVID-19-positive patients, indicating that the virus may influence kidney function. The median urea concentration of 34 mg/dL and the median creatinine concentration of 1.0 mg/dL in COVID-19-positive individuals are statistically different from the control group, with P-values of 0.001 for both measures. demonstrates the significant impact of COVID-19 on renal function. In contrast, a P-value of

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0.134 suggested that the median uric acid concentration of 4.4 mg/dL in COVID-19-positive patients did not vary statistically from the control group. It should be highlighted, however, that changes in renal function in COVID-19 instances can still be detected by monitoring uric acid levels. These findings align with the broader understanding of COVID-19's impact on renal function. Studies such as those have also reported abnormalities in biochemical markers associated with severe illness and mortality in COVID-19, including those related to kidney function(L. Hu et al., 2020; D. Wang et al., 2020). Additionally, the study highlighted the importance of monitoring renal function in COVID-19 patients aligns with other studies reporting elevated blood urea nitrogen (BUN) and creatinine in COVID-19 patients Though not statistically different, uric acid levels still fall within the elevated range reported in some COVID-19 cases(Tsuchihashi et al., 2021) . Regarding the lipid profile, with a P-value of 0.142, the median HDL-C level in Positive RT-PCR patients is 10 mg/dL (interquartile range: 28-38). Although the P-value is not statistically significant, it is crucial to consider the consequences. Studies have suggested an association between decreased HDL-C levels and viral infections(Mazidi, Mikhailidis, & Banach, 2019). The non-significant result may encourage further exploration to understand better the role of HDL-C in COVID-19 and its possible implications for cardiovascular health. The median LDL-C level is 35 mg/dL (interquartile range: 108-144), with a non-significant P-value of 0.476. While the conclusion is not statistically significant, research has suggested a relationship between altered lipid metabolism, including LDL-C, and COVID-19 severity(Wei et al., 2020). The median total cholesterol level is 44 mg/dL (interquartile range: 142-186) with a P-value of 0.858 which is not statistically significant. This result is consistent with previous research that found dyslipidaemia a prevalent finding in COVID-19 patients(Hu, Chen, Wu, He, & Ye, 2020).The non-significant P-value, on the other hand, underscores the necessity for a thorough investigation of lipid profiles in COVID-19. And the median triglyceride level is 50 mg/dL (interquartile range: 117-168), with a non-significant P-value of 0.225. Previous research has revealed a link between triglyceride levels and COVID-19 severity(Fan et al., 2020). With a P-value of 0.001, the median CRP level of 50 mg/L in Positive RT-PCR patients indicated a significant inflammatory response. CRP is a well-established inflammatory marker that has been regularly observed to be increased in severe COVID-19 cases. This finding aligns with studies indicating the role of CRP as a prognostic marker for disease severity and progression (N. Chen et al., 2020; Huang et al., 2020) Ferritin with a P-value of 0.001, the median ferritin level of 818 ug/L in positive RT-PCR patients indicated a significant increase. Ferritin is an acute-phase reactant frequently increased in inflammatory diseases such as COVID-19. Elevated ferritin levels have been associated with a cytokine storm, a severe immune reaction in some COVID-19 patients. aligns with the understanding that ferritin can indicate a hyperinflammatory state in severe cases(Mehta et al., 2020; Zhou et al., 2020).

Conclusions:

In conclusion, this study emphasizes COVID-19' diverse impact on numerous physiological systems, indicating significant changes in glucose metabolism, liver function, renal dynamics, and inflammatory markers. Consistent findings of the significance of ongoing monitoring and further investigation of these metabolic parameters in COVID-19 patients. The identified patterns help to advance our understanding of the virus's pathogenesis and provide valuable insights for clinical management and future research.

Conflicts of Interest

All authors declare no conflicts of interest.

Abbreviations

Abbreviations	**Term**
ALT	Alanine Aminotransferase
AST	Aspartate Aminotransferase
COVID-19	Coronavirus Disease-2019
CBC	Complete Blood Count
CRP	C-reactive Protein
GGT	Gamma-glutamyl Transferase
HDL-C	High Density Lipoprotein-cholesterol
LDL-C	Low Density Lipoprotein-cholesterol
LDH	Lactate Dehydrogenase
RT-PCR	Reverse-Transcriptase Polymerase Chain Reaction
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus-2

Reference

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