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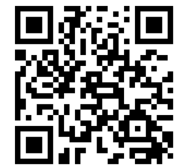

Effect of COVID-19 Treatments on Kidney Function Within Type 2 Diabetic Iraqi Patients

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Abstract

Recent studies have shown that the use of anti-inflammatory corticosteroids (especially dexamethasone) in individuals with COVID-19 can help prevent respiratory damage and death by modifying the inflammatory injury that occurs in the lung. This research was conducted to evaluate the effect of the use of anti-inflammatory corticosteroids on the level of diabetes and kidney function in patients with COVID-19. The study was conducted at Al-Shifa Hospital for quarantine in Ramadi city on 160 patients with COVID age range (40-70 years), some of whom had diabetes and the other did not have diabetes. They were treated with corticosteroids such as dexamethasone, hydrocortisone suspension 100 mg and prednisolone, with monitoring of diabetes levels and kidney function for all patients. Results: The results showed that diabetes levels increased for some patients with a decline in kidney function, while others showed improvement in diabetes and kidney levels, and the third group was fluctuating, i.e. as the change in diabetes levels and kidney function fluctuated between the negative and positive outcomes of the patients' health condition. Conclusion: It was found that large amounts of corticosteroids used negatively affect diabetes levels and thus kidney function test, so it is necessary to conduct additional studies on the virus, especially after its recent resurgence in its mutated form, which affects all age groups of humans, is a concern.

Keywords: COVID-19, Treatments, Kidney function, Type 2 diabetic, Patients

1. Introduction

The COVID pandemic that swept the world in late 2019 and claimed the lives of many people in different countries of the world has become a major challenge to public health as the symptoms of the disease were not clear in all infected people (Romanou et al., 2021) as it is no less dangerous than smoking and drinking alcohol, which still claim many lives, especially addicts (Marouf et al., 2024, Marouf et al., 2025). Recent studies have shown that the use of anti-inflammatory corticosteroids (especially dexamethasone) in individuals with Covid-19 can help reduce deaths by 1/3 for patients on ventilators and 1/5 for patients receiving oxygen therapy (Aqbal et al., 2024). In addition, studies have shown that diabetics are at higher risk of contracting COVID-19 and are therefore more likely to develop severe complications, i.e., significantly increased mortality and morbidity . In addition, studies have shown that diabetics are at higher risk of contracting COVID-19 and therefore will be more susceptible to severe complications, i.e. a significant increase in mortality and morbidity (Centers for Disease Control and Prevention, 2022). COVID-19 has also been shown to cause insulin resistance and reduce insulin production due to direct damage to pancreatic beta cells (Centers for Disease Control and Prevention, 2022). The use of dexamethasone treatment will further complicate this condition, especially in patients with pre-existing diabetes who are at risk of developing diabetes. Steroids exacerbate hyperglycemia, especially postprandial hyperglycemia, and may reveal undiagnosed diabetes in people at risk of developing the disease (Saand et al., 2021).

At the end of 2020, the World Health Organization recommended the use of steroid compounds, especially dexamethasone, due to its effectiveness in treating respiratory damage and reducing the incidence of kidney failure in patients (Rubin et al., 2024). Although other studies have shown that the use of

Received 12 March 2026; accepted 11 May 2026.
Available online 20 May 2026

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https://doi.org/10.70492/2664-0554.1165
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dexamethasone increases the incidence of kidney failure, meaning that the extent of the negative effects of its use in treating Covid patients is not yet clear (Hsu et al., 2022).

Diabetics commonly develop CKD (35% of diabetic patients) due to their immunosuppression, which leads to chronic inflammation of the gastrointestinal tract due to their immunosuppression, which will lead to infectious complications and then death (Abdulaziz Al-Muhanna et al., 2022). Recently (July 2025), cases of infection with the modified Coronavirus appeared in Iraq at a rate of 95% (Dantas et al., 2025). Its symptoms are similar to the symptoms of infection with the common flu. Recent research has confirmed the spread of the virus globally, with the presence of deaths, especially in countries that do not have sufficient health care and continuous monitoring, such as Brazil and El Salvador (Sott et al., 2022, Tomasiello et al., 2024). Objective: the objective of this study was to evaluate the effect of steroid use on kidney function and diabetes in COVID-19 patients during the period of its use.

2. Materials and methods

The study was conducted at Al-Shifa Hospital for quarantine in Ramadi city on 160 participants (80 men and 80 women). After venous blood was drawn, blood was divided into two sample types first type samples contain a whole blood with anticoagulant material to measure HbA1c (glycated haemoglobin, A1c) and the second type samples plan tubes which contain blood only then put them into centrifuge for separated serum to measure daily glucose levels were measured before and after corticosteroid doses were given, including doses of decadron, hydrocortisone suspension 100 mg and prednisolone. Patients whose their blood sugar level have increased have been given units of insulin as needed and under the supervision of the specialist doctor and in quantities ranging from 10 insulin units to 25 or 30 insulin units, according to the needs of the affected case and who has a defect in the rate of high and low blood sugar. Renal functions were also measured in the serum of the patients after corticosteroid doses, where urea, creatinine and uric acid levels were also measured for all patients and the healthy group as well as.

The 160 subject were divided into four groups, each group consisting of 40 people, where group1 is a control, group 2 is a group benefiting from treatment, group 3 is a group not benefiting from treatment, and group 4 is fluctuating in benefiting from treatment.

2.1. Groups of study

1- **G1** is healthy people.
2- **G2** is benefiting from treatment.
3- **G3** is not benefiting from treatment.
4- **G4** is fluctuating in benefiting from treatment.

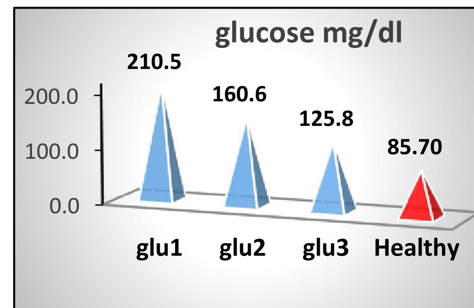

Fig. 1. Avery worth demonstrates the average ± S.E.M of glucose1, glucose2 and glucose3 as (glu1, glu2 and glu3 respectively) of group benefiting from treatment G2 compare to healthy group G1 respectively.

2.2. Statistical analysis

The statistical analyses of this study were conducted using the statistical analysis system for data management, advanced analysis and multivariate analysis in order to show the statistically significant and non-significant effects of the various research variables as well as to calculate the least significant difference tests (p value). LSD analysis was also used for all results to compare the standard deviations of the values with their means.

2.3. Ethical approval

The study was conducted in accordance with the ethical principles followed by obtaining the patients' consent to draw blood samples from them and the approval of the local ethics committee according to document No. 6620.

3. Results

The results of this study, according to the protocol followed in treating COVID patients with large doses of corticosteroids on 120 COVID patients compared to the healthy group in the quarantine hospital in Anbar/Ramadi, showed various results and were divided into three groups according to the patients' response to treatment during their hospital stay.

The results of the second group (approximately 25% of the total number of patients) showed a positive response to the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of fasting glucose glu1, glu2 and glu3 separately were (210.50 ± 98.28, 160.60 ± 55.70 & 125.80 ± 30.52) compare to the healthy group 85.70 ± 9.11) as shown in Fig. 1.

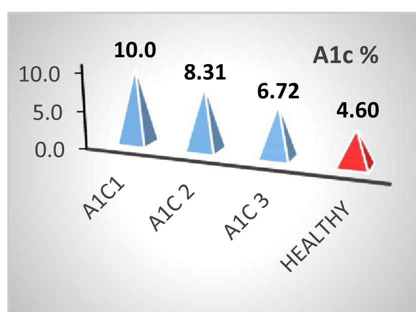

Fig. 2. Avery worth demonstrates the average ± S.E.M of HbA1c results as A1c1, A1c2 and A1c3 of group benefiting from treatment G2 compare to healthy group G1 respectively.

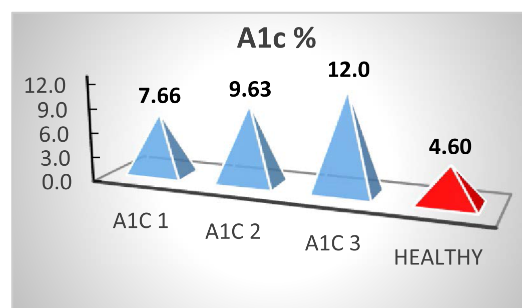

Fig. 4. Avery worth demonstrates the average ± S.E.M of HbA1c results as A1c1, A1c2 and A1c3 of group not benefiting from treatment G3 compare to healthy group G1 respectively.

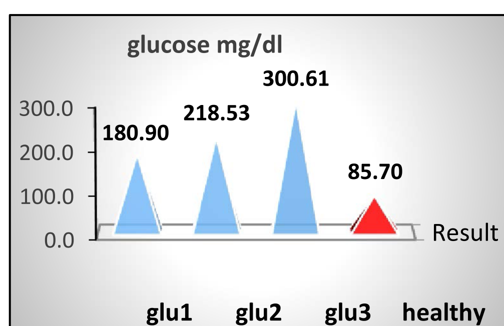

Fig. 3. Avery worth demonstrates the average ± S.E.M of glucose1, glucose2 and glucose3 as (glu1, glu2 and glu3 respectively) of group not benefiting from treatment G3 compare to healthy group G1 respectively.

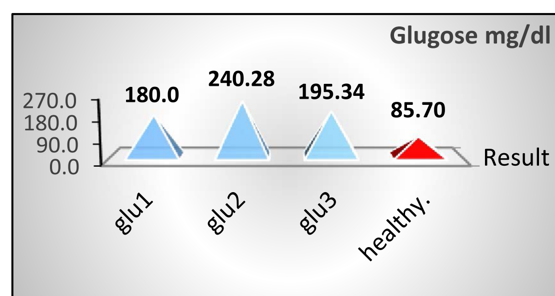

Fig. 5. Avery worth demonstrates the average ± S.E.M of glucose1, glucose2 and glucose3 as (glu1, glu2 and glu3 respectively) of group fluctuating in benefiting from the treatment G4 compare to healthy group G1 respectively.

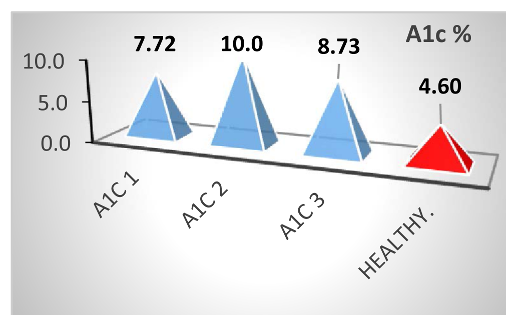

Fig. 6. Avery worth demonstrates the average ± S.E.M of A1c results as A1c1, A1c2 and A1c3 of group fluctuating in benefiting from treatment G4 compare to healthy group G1 respectively.

Also, HbA1c worth's of G2 (group benefiting from treatment) explained a positive response to the treatment protocol followed by the doctors in the hospital as A1c1, A1c2 and A1c3, their (average ± S.E.M) were (10.0 ± 0.22, 8.31 ± 0.29 & 6.72 ± 0.33) compare to healthy group G1 (4.60 ± 0.41) respectively, as explained in Fig. 2.

Moreover the results of the third group G3 which not benefiting from treatment (were about approximately 25% of the total number of patients) explained a negative response to the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of fasting glucose glu1, glu2 and glu3 separately were (180.90 ± 68.18, 218.53 ± 95.77 & 300.61 ± 130.18) compare to healthy group G1 (85.70 ± 9.11) respectively, as noticed in Fig. 3.

Also, HbA1c results of group not benefiting from treatment G3 which demonstrates a negative response to the treatment protocol followed by the doctors in the hospital as A1c1, A1c2 and A1c3, their (average ± S.E.M) were (7.66 ± 0.12, 9.63 ± 0.42 & 12.0 ± 0.54 respectively) compare to healthy group G1 (4.60 ± 0.41) as explained in Fig. 4.

The results of the forth group G4 (approximately 50% of the total number of patients) showed a fluctuating in benefiting from the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of fasting glucose glu1, glu2 and glu3 separately were (180.0 ± 77.21, 240.28 ± 150.17 & 195.34 ± 100.82) compare to healthy group G1 (85.70 ± 9.11) as shown in Fig. 5.

Again, HbA1c results of group G4 (approximately 50% of the total number of patients) which demonstrates fluctuating in benefiting from treatment protocol followed by the doctors in the hospital as A1c1, A1c2 and A1c3, their (average ± S.E.M) were (7.72 ± 0.22, 10.0 ± 0.95 & 8.73 ± 0.63 respectively) compare to healthy group G1 (4.60 ± 0.41) as explained in Fig. 6.

Table 1. Demonstrates daily blood sugar and A1c results for three patient's groups compare to the healthy group with their p value, LSD and total % of all patients.

Group No.	Glucose mg/dl Result (mean ± SEM)	p value	LSD	Total % of All Patients
(G1)	85.0 ± 9.11			
(G2)				25%
glu1	210.50 ± 98.28	p < 0.001	3.84	
glu2	160.60 ± 55.70	p < 0.001	3.84	
glu3	125.80 ± 30.52	p < 0.001	3.84	
(G3)				25%
glu1	180.90 ± 68.18	p < 0.001	3.84	
glu2	218.53 ± 95.77	p < 0.001	3.84	
glu3	300.61 ± 130.18	p < 0.001	3.84	
(G4)				50%
glu1	180.0 ± 77.21	p < 0.001	3.84	
glu2	240.28 ± 150.17	p < 0.001	3.84	
glu3	195.34 ± 100.82	p < 0.001	3.84	
	HbA1c % Result (mean ± SEM)			
(G1)	4.60 ± 0.41			
(G2)				25%
A1c1	10.0 ± 0.22	p < 0.001	3.84	
A1c2	8.31 ± 0.29	p < 0.001	3.84	
A1c3	6.72 ± 0.33	p < 0.001	3.84	
(G3)				25%
A1c1	7.66 ± 0.12	p < 0.001	5.42	
A1c2	9.63 ± 0.42	p < 0.001	5.42	
A1c3	12.0 ± 0.54	p < 0.001	5.42	
(G4)				50%
A1c1	7.72 ± 0.22	p < 0.001	6.90	
A1c2	10.0 ± 0.95	p < 0.001	6.90	
A1c3	8.73 ± 0.63	p < 0.001	6.90	

Table 1: Demonstrates of daily blood glucose and A1c results for three patient groups compared to the healthy group. The benefit group included 25% of total percentage of all patients, and the non-benefit group also included 25% of patients, but the latter group showed fluctuating results, representing 50%, according to the treatment protocol followed by the doctors at the hospital.

Furthermore results of the second group G2 (approximately 25% of the total number of patients) offered a positive response to the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of blood urea as B.u1, B.u2 and B.u3 separately were (43.99± 7.18, 36.85 ± 8.17 & 31.43 ± 10.18) compare to the healthy group 24.60 ± 19.01) as shown in Fig. 7.

Whereas the results of the third group G3 which not benefiting from treatment (were about approximately 25% of the total number of patients) explained a negative response to the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of blood urea as B.u1, B.u2 and B.u3 separately were (35.12± 8.18, 43.48 ± 9.77 & 55.89 ± 4.18) compare to healthy group G1 (24.60 ± 19.01) respectively, as noticed in Fig. 8.

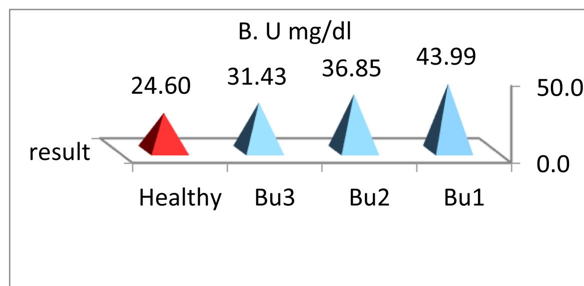

Fig. 7. Avery worth demonstrates the average ± S.E.M of blood urea as B.u1, B.u2 and B.u3 separately of group benefiting from treatment G2 compare to healthy group G1 respectively.

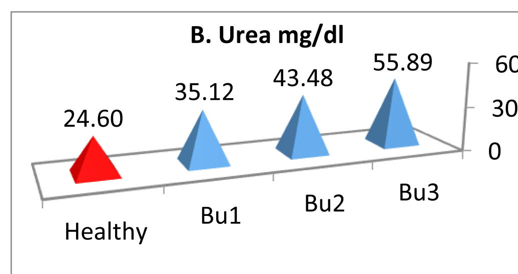

Fig. 8. Avery worth demonstrates the average ± S.E.M of blood urea as B.u1, B.u2 and B.u3 separately of group not benefiting from treatment G3 compare to healthy group G1 respectively.

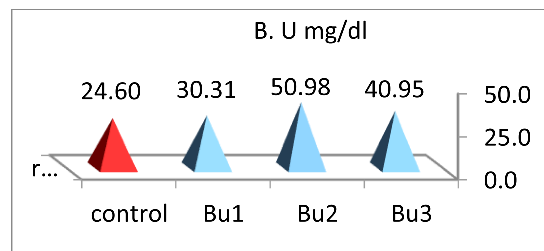

Fig. 9. Avery worth demonstrates the average ± S.E.M of blood urea as B.u1, B.u2 and B.u3 separately of group fluctuating in benefiting from treatment G4 compare to healthy group G1 respectively.

Else the results of the forth group G4 (approximately 50% of the total number of patients) showed a fluctuating in benefiting from the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of blood urea as B.u1, B.u2 and B.u3 separately were (30.31 ± 7.21, 50.98 ± 5.17 & 40.95 ± 8.82) compare to healthy group G1 (24.60 ± 19.01) as shown in Fig. 9.

Likewise results of the second group G2 (approximately 25% of the total number of patients) offered a positive response to the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of blood creatinine as Cr1, Cr2 and Cr3 separately were (1.20 ± 0.82, 0.84 ± 0.51 & 0.63 ± 0.42) compare to the healthy group (0.51 ± 0.31) as shown in Fig. 10.

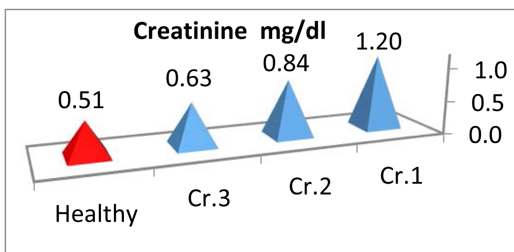

Fig. 10. Avery worth demonstrates the average ± S.E.M of blood creatinine as S.Cr1, S.Cr2 and S.Cr3 separately of group benefiting from treatment G2 compare to healthy group G1 respectively.

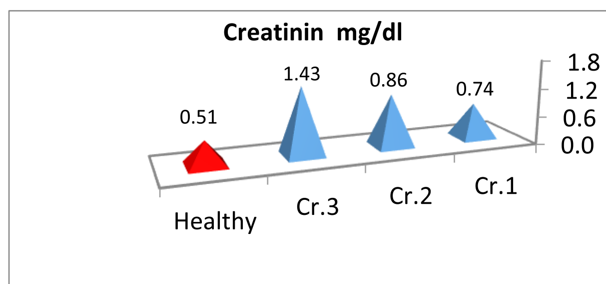

Fig. 11. Avery worth demonstrates the average ± S.E.M of blood creatinine as Cr1, Cr2 and Cr3 separately of group not benefiting from treatment G3 compare to healthy group G1 respectively.

Also, the results of the third group G3 which not benefiting from treatment (were about approximately 25% of the total number of patients) explained a negative response to the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of blood creatinine as Cr1, Cr2 and Cr3 separately were (0.74± 0.48, 0.86 ± 0.67 & 1.43 ± 0.81) compare to healthy group G1 (0.51 ± 0.31) respectively, as noticed in Fig. 11.

Else the results of the forth group G4 (approximately 50% of the total number of patients) showed a fluctuating in benefiting from the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of blood creatinine as Cr1, Cr2 and Cr3 separately were (0.68 ± 0.71, 0.84 ± 0.61 & 1.03 ± 0.82) compare to healthy group G1 (0.51 ± 0.31) as shown in Fig. 12.

Likewise results of the second group G2 (approximately 25% of the total number of patients) offered a positive response to the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of blood uric acid as U.A1, U.A2 and U.A3 separately were (6.42 ± 3 .28, 5.54 ± 2.10 & 3.81 ± 1.52) compare to the healthy group (4.01 ± 2.11) as shown in Fig. 13.

Also, blood uric acid results of group not benefiting from treatment G3 which demonstrates a negative response to the treatment protocol followed by the doctors in the hospital as A1c1, A1c2 and A1c3, their

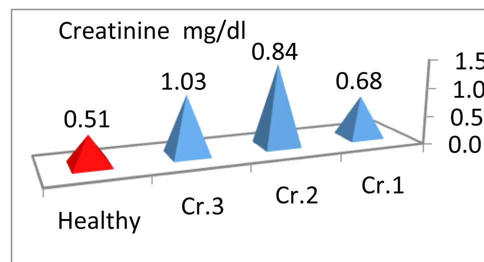

Fig. 12. Avery worth demonstrates the average ± S.E.M of blood creatinine as Cr1, Cr2 and Cr3 separately of group fluctuating in benefiting from treatment G4 compare to healthy group G1 respectively.

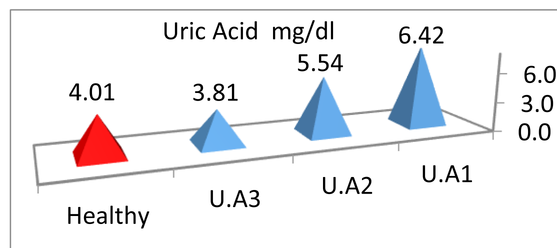

Fig. 13. Avery worth demonstrates the average ± S.E.M of blood uric acid as U.A1, U.A2 and U.A3 separately of group benefiting from treatment G2 compare to healthy group G1 respectively.

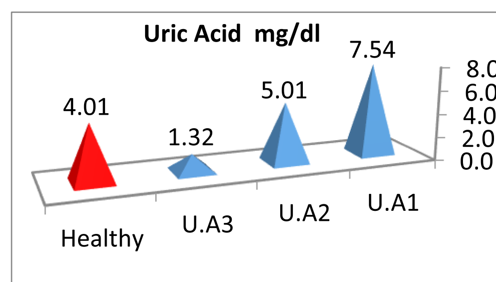

Fig. 14. Avery worth demonstrates the average ± S.E.M of blood uric acid as U.A1, U.A2 and U.A3 respectively of group not benefiting from treatment G3 compare to healthy group G1 separately.

(average ± S.E.M) were (7.54 ± 3.12, 5.01 ± 2.42 & 1.32 ± 1.14 respectively) compare to healthy group G1 (4.01 ± 2.11) as explained in Fig. 14.

Likewise the results of the forth group G4 (approximately 50% of the total number of patients) showed a fluctuating in benefiting from the treatment protocol followed by the doctors in the hospital, their (average ± SEM) of blood uric acid as U.A1, U.A2 and U.A3 separately were (7.05 ± 4.21, 5.16 ± 2.17 & 2.51 ± 1.82) compare to healthy group G1 (4.01 ± 2.11) as shown in Fig. 15.

Table 2: Demonstrates of Kidney Faction Test results for three patient groups compared to the healthy group. The benefit group included 25% of total percentage of all patients, and the non-benefit group also included 25% of patients, but the latter group showed

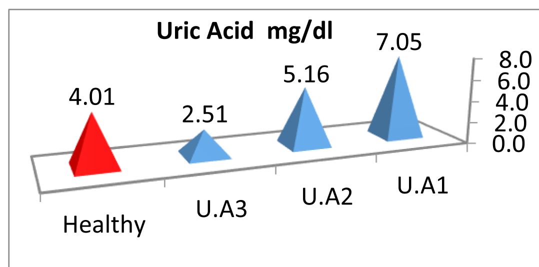

Fig. 15. Avery worth demonstrates the average ± S.E.M of blood acid as U.A1, U.A2 and U.A3 separately of group fluctuating in benefiting from treatment G4 compare to healthy group G1 respectively.

fluctuating results, representing 50%, according to the treatment protocol followed by the doctors at the hospital.

4. Discussion

Many studies have been conducted on the coronavirus, especially after its spread at the end of 2019, which caused the deaths of many infected people worldwide and became a global pandemic due to its alarming spread in all countries of the world (Najim et al., 2024, Corral-Gudino et al., 2021). Our study complements previous studies on the virus, where this study aims to clarify the negative and positive effects of the protocol followed by the doctors in treating the coronavirus. Although the virus may have disappeared temporarily (Laituri et al., 2025), it continues to circulate in a modified form (Dantas et al., 2025). Therefore, it is essential to continue studying how to treat those infected with this virus by following a safe protocol to minimize the side effects of the treatments used, maintain the health of patients, and reduce the number of deaths from this virus, which peaked in 2019, becoming a global pandemic that killed millions worldwide, especially the elderly (Marouf et al., 2023).

In our current study, 160 venous blood samples were collected from volunteers to contribute to this research and they were divided into four groups, where the first group was a healthy group not infected with any disease, so it was considered a control group for the other three groups respectively, which in turn included the second, third and fourth groups of patients infected with the COVID virus.

The results of the second group showed a positive response to the COVID-19 treatment protocol followed by the doctors at the quarantine hospital in Ramadi, specifically in the 5-Kilometer area. This group constituted 25% of the total number of COVID-19 patients participating in this study, as illustrated in Fig. 1 which shows the daily blood sugar results for patients in the second group and Fig. 2 shows the HbA1c results for the same group with a positive response. While Figs. 7, 10 and 13, appears the kidney function test results (urea, creatinine and uric acid respectively) for the second group. Fig. 7 shows the blood urea test results, Fig. 10 shows the creatinine test results and Fig. 13 shows the uric acid test results for the second group with a positive response (Romanou et al., 2021). In contrast, the results of the third group showed the complete opposite, indicating a lack of benefit from the hospital's treatment protocol. Fig. 3 Fig. 4 show the daily blood sugar and HbA1c results for the group, respectively. Also Figs. 8, 11 and 14 show the kidney function results for

Table 2. Demonstrates blood kidney faction test results for three patient's groups compare to the healthy group.

Group No.	Blood Urea mg/dl Result (mean ± SEM)	p value	LSD	Total % of All Patients
(G1)	24.60 ± 19.01			
(G2)				25%
B.u1	43.99± 7.18	p < 0.006	5.38	
B.u2	36.85 ± 8.17	p < 0.006	5.38	
B.u3	31.43 ± 10.18	p < 0.006	5.38	
(G3)				25%
B.u1	35.12± 8.18	p < 0.006	5.38	
B.u2	43.48 ± 9.77	p < 0.006	5.38	
B.u3	55.89 ± 4.18	p < 0.006	5.38	
(G4)				50%
B.u1	30.31 ± 7.21	p < 0.006	5.38	
B.u2	50.98 ± 5.17	p < 0.006	5.38	
B.u3	40.95 ± 8.82	p < 0.006	5.38	
	Blood Creatinine mg/dl Result (mean ± SEM)			
(G1)	0.51 ± 0.31			
(G2)				25%
Cr1	1.20 ± 0.82	p < 0.001	0.255	
Cr2	0.84 ± 0.51	p < 0.001	0.255	
Cr3	0.63 ± 0.42	p < 0.001	0.255	
(G3)				25%
Cr1	0.74± 0.48	p < 0.001	0.255	
Cr2	0.84 ± 0.67	p < 0.001	0.255	
Cr3	1.43 ± 0.81	p < 0.001	0.255	
(G4)				50%
Cr1	0.74 ± 0.71	p < 0.001	0.255	
Cr2	0.84 ± 0.61	p < 0.001	0.255	
Cr3	1.03 ± 0.82	p < 0.001	0.255	
	Blood Uric Acid mg/dl Result (mean ± SEM)			
(G1)	4.01 ± 2.11			
(G2)				25%
U.A1	6.42 ± 3 .28	p < 0.0012	4.27	
U.A2	5.54 ± 2.10	p < 0.0012	4.27	
U.A3	3.81 ± 1.52	p < 0.0012	4.27	
(G3)				25%
U.A1	7.54 ± 3.12	p < 0.0012	4.27	
U.A2	5.01 ± 2.42	p < 0.0012	4.27	
U.A3	1.32 ± 1.14	p < 0.0012	4.27	
(G4)				50%
U.A1	7.05 ± 4.21	p < 0.0012	4.27	
U.A2	5.16 ± 2.17	p < 0.0012	4.27	
U.A3	2.51 ± 1.82	p < 0.0012	4.27	

the third group, including blood urea, creatinine, and uric acid levels, respectively, which a demonstrating a significant decrease in uric acid levels. A significant increase in urea and creatinine levels and these results are supported by some contemporary studies on the treatment of COVID-19 patients (Al-Muhanna et al., 2022, Chen & Zhang, 2021, Dufour et al., 2021).

Furthermore, the results for the last group of patients, Group 4, varied between positive and negative outcomes of the protocol followed by physicians to treat patients with the virus. This group represented 50% of the total number of patients, as seen in Figs. 5 and 6, which illustrate the daily and HbA1c levels, respectively, for patients in Group 4. Meanwhile, the varying results for kidney function were observed in Figs. 9, 12 and 15, which showed the results for blood urea, creatinine, and uric acid levels, respectively, for the patients which showed varying results with the protocol followed using corticosteroids, which is consistent with some studies (Gordon et al., 2022, Rhou et al., 2022).

Table 1 again shows the mean values and standard deviation of daily and HbA1c results for all patient groups compared to the healthy group, and Table 2 shows the results of kidney function tests, represented by the mean values and their standard deviations for the three disease groups compared to the healthy group (Korytkowski & Muniyappa, 2022).

5. Conclusion

We conclude that corticosteroids can be used to treat COVID-19 patients according to the guidelines and recommendations of the World Health Organization (Patel et al., 2021). However, their use should be limited to moderate, severe, or critical cases requiring hospitalization, given their side effects, which can lead to elevated blood sugar levels and subsequent kidney dysfunction. This was evident in the blood sugar and kidney function results, which indicated that the current protocol needs to be modified, as the mortality rate was 25% of the total number of patients. This was clearly demonstrated in the blood sugar and uric acid results, which can be used as warning indicators of worsening patient health, with low uric acid levels, high daily blood sugar and high HbA1c levels, respectively (Patel et al., 2020, Tallon et al., 2022). Therefore, further research on the virus is crucial, especially given its recent resurgence in a mutated form affecting all age groups a worrying development.

6. Recommendations

We recommend conducting detailed studies of the protocols used in treating patients with the virus, as well as additional studies on the ways the virus mutates and develops resistance to treatments used to prevent reinfection in individuals.

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