



Ramadan Fasting and Patients with Renal Disorders: A Literature Review

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ARTICLE INFO	ABSTRACT
<p><i>Article type:</i> Review Article</p>	<p>Millions of Muslims observe fasting during the holy month of Ramadan and other days of the lunar calendar year across the world. During this period, the believers of Islam refrain from eating and drinking from the sunrise until the sunset. The absence of fluid intake during Ramadan fasting leads to dehydration, which may affect the renal health. Although ill individuals are exempted from Ramadan fasting, the majority of patients may prefer fasting during Ramadan. This review aimed to summarize the effects of Ramadan fasting in patients with various renal disorders, including chronic kidney disease (CKD), nephrolithiasis, urolithiasis, and end-stage renal disease, as well as those received kidney transplant, and those receiving hemodialysis, peritoneal dialysis, and intestinal dialysis. The literature review was conducted via searching in databases such as Medline, PubMed, PMC, Google Scholar, ScienceDirect, DOAJ, Cochrane Library, and other reference lists. According to the findings, the restriction of water intake during Ramadan fasting could lead to acute tubular cell injury, and patients with CKD should consult healthcare professionals at least one month before Ramadan and should fast under close medical supervision [21]. In addition, the patients with renal colic who are willing to fast during Ramadan should be advised to consume adequate water during their non-fasting hours to reduce the potential risk of dehydration, while the patients receiving dialysis and kidney transplant who are willing to fast during Ramadan should be monitored closely. Overall, patients with renal disorders could fast safely during Ramadan under medical supervision.</p>
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Introduction

Millions of Muslims observe Ramadan fasting during the holy month of Ramadan and other days of the lunar calendar year across the world. During this period, the believers in Islam refrain from eating and drinking before the sunrise until the sunset. Depending on the season and geographical location, the duration of Ramadan fasting may be within 12-18 hours per day on average.

Islam is the fastest growing religion in the world, and it has been estimated that the Muslim population was approximately 1.6 billion in 2010 [1] and 1.8 billion in 2015 worldwide [2]. It has also been predicted that the global Muslim population may reach nearly three billion in 2060 [2].

Ramadan fasting is associated with numerous health benefits, including weight loss, reduced insulin resistance, blood glucose, and blood pressure, improved lipid profile, prevention of various disorders (e.g., obesity, diabetes, cardiovascular diseases, and cancer), protection

against neurodegeneration, diminished inflammation, improved health span, and extended life span, which are similar to the health benefits of alternate-day fasting and time-restricted feeding [3].

According to the literature, Ramadan fasting could improve the fasting blood glucose by improving insulin sensitivity [4], increasing the insulin-mediated glucose uptake [5], and decreasing insulin resistance [6]. In addition, Ramadan fasting could enhance the lipid profile by decreasing the plasma levels of triglyceride and high-density lipoprotein cholesterol [7]. Moreover, Ramadan fasting could decrease the levels of inflammatory markers, such as the C-reactive protein, interleukin-6, and homocysteine in healthy individuals [8], while significantly decreasing the systolic and diastolic blood pressure [9].

Only a few manageable adverse effects have been attributed to Ramadan fasting, such as dehydration, headache, heartburn, constipation, decreased sleep quality, and anemia, which could

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be avoided by a balanced diet containing fruits, vegetables, whole grains, and dairy products and avoiding bulky, fatty, and fried foods and drinking sufficient fluids, such as water, fruit juices, and soups [10].

The absence of fluid intake during the Ramadan fasting (especially in hot summer months) leads to dehydration [11], with the thirst and urinary concentration mechanisms contributing to maintaining the water balance through the reduction of the urine output and increasing the urine concentration in dehydration in healthy individuals. In addition, Ramadan fasting in patients with renal diseases [12] could affect the body homeostasis and metabolism.

According to the literature, the urine output and excretion of electrolytes such as sodium, calcium, magnesium, and phosphate could decrease during Ramadan fasting compared to other months. Meanwhile, the serum levels of metabolites such as uric acid, urea, and creatinine have been reported to be either normal or slightly increased during Ramadan fasting [13]. The risk of mild or moderate hypoglycemia, cardiovascular events, and hospital admissions does not increase due to Ramadan fasting in patients with diabetes and moderate chronic kidney disease (CKD) [14]. Fasting for 12 -14 hours could result in mild ketosis [15], and under certain circumstances, fasting ketosis may become severe and lead to overt ketoacidosis. Fasting-induced dehydration, decreased blood pressure, changes in specific electrolytes, and ketosis may affect the renal health. Although ill individuals are exempted from the Islamic fasting, the majority of patients may prefer fasting during Ramadan [10].

This review aimed to summarize the effects of Ramadan fasting, especially in patients with renal disorders, including CKD, nephrolithiasis, urolithiasis, and end-stage renal disease, as well as those receiving kidney transplants, hemodialysis, peritoneal dialysis, and intestinal dialysis.

Materials and Methods

The literature review was performed via searching in databases such as Medline, PubMed, PMC, ScienceDirect, Google Scholar, DOAJ, Cochrane Library, and other reference lists using keywords such as Ramadan fasting, Ramadan fasting, chronic kidney disease, nephrolithiasis, urolithiasis, end-stage renal disease, kidney transplants, hemodialysis, peritoneal dialysis,

and intestinal dialysis. The review was focused on the publications since the year 2000 in order to identify the latest updates regarding the impact of Ramadan fasting on renal diseases. Several publications were identified in relation to Ramadan fasting and renal diseases by searching in various databases since 2000, and only clinical case reports, case series, and prospective and retrospective observational studies published in English were selected for the review. Moreover, full-text articles were selected for the review, while duplicates were excluded.

Ramadan Fasting and CKD

The prospective observational studies conducted in the United Kingdom [14], Israel [16], Turkey [17], and United Arab Emirates [18] have suggested that month-long Ramadan fasting might be safer in patients with CKD as these studies have shown no deterioration of the renal functions in these patients.

In a study in this regard, Chowdhury et al. [14] observed the outcomes of fasting in patients with diabetes and CKD, reporting no significant changes in their body weight, blood pressure, creatinine, glycated hemoglobin (HbA1C), cholesterol, and urinary protein-creatinine ratio due to Ramadan fasting. On the other hand, Hassan et al. [16] investigated the changes in the hydration status and blood analysis of the urea, creatinine, and brain natriuretic peptide (BNP) levels due to Ramadan fasting in patients with CKD grades 2-4. In the mentioned study, a significant elevation was observed in the serum urea levels of the fasting patients, while the hydration status indices and plasma BNP levels decreased and returned to normal after four weeks.

In another study, Kara et al. [17] reported that serum creatinine levels elevated, while the estimated glomerular filtration rate (eGFR) was lower in non-fasting patients with CKD compared to CKD patients during Ramadan fasting. Meanwhile, Bernieh *et al.* [18] observed the reduction of the mean body weight, systolic and diastolic blood pressure, triglycerides, and urinary protein excretion, along with the improved eGFR in the patients with CKD who fasted during Ramadan.

Conversely, a study conducted in Egypt [19] indicated that the risk of adverse cardiovascular events was higher among the patients with CKD and pre-existing cardiovascular disease. In this regard, the findings of NasrAllah *et al.* [19]

demonstrated that the use of the renin-angiotensin-aldosterone system blockers and diuretics was associated with the increased serum creatinine on day seven of fasting in the fasting CKD patients during Ramadan. Moreover, a prospective observational study in Saudi Arabia [20] indicated that renal functions deteriorated due to Ramadan fasting in patients with CKD of stage three or higher. According to Bakhit et al. [20], Ramadan fasting in patients with CKD resulted in elevated creatinine levels, improved mean systolic blood pressure, significant reduction of HbA1c, and improved diabetic control. Therefore, patients with CKD should consult healthcare professionals at least one month before Ramadan and should fast under close medical supervision as the restriction of water during Ramadan fasting could lead to acute tubular cell injury in these patients [21].

Ramadan fasting and Renal Colic

The prospective observational studies in Iran [22] and Turkey [23] and retrospective observational studies in Iran [24] and Saudi Arabia [25] have reported no increase in the risk of urinary tract stones in the comparison of Ramadan with other non-fasting months. In a study conducted by Miladipour et al. [22], the findings indicated the significant reduction of the total excretion of calcium, phosphate, and magnesium in the 24-hour urine and urine volume, as well as the significantly higher urine concentrations of uric acid, citrate, phosphate, sodium, and potassium, and no significant increase in the calcium oxalate supersaturation in men during Ramadan fasting.

According to the research by Cevik et al. [23], Ramadan fasting in patients with renal colic induced significant changes in some parameters, such as hemoglobin, general crystal, and triple phosphate crystal. Furthermore, Basiri et al. [24] reported that the frequency of admissions due to renal colic was significantly higher in warm seasons, and no significant difference was observed in this regard in colder months compared to Ramadan. An observational study by Al Mahayni et al. [25] also indicated that the rate of urinary tract stones was higher in the subjects aged more than 40 years, and most of the urinary tract stones were formed in the ureter.

Contrarily, a retrospective study performed in Israel [26] and a prospective observational study

in Iran [27] showed that the number of the emergency department visits due to renal colic was high during the first two weeks of Ramadan. In this regard, Abdolreza et al. [27] and Sagy et al. [26] reported that the hospital admissions due to renal colic were significantly higher during the first two weeks of Ramadan. In addition, the study by Sagy et al. [26] indicated that the frequency of emergency department (ED) visits due to renal colic was higher during summer, and per every increase of temperature by 1°C, the frequency of ED visits increased by 2-4%. Therefore, it could be concluded that the patients with renal colic who willing to fast during Ramadan should be advised to consume adequate water during their non-fasting hours to reduce the potential risk of dehydration.

Ramadan Fasting and Dialysis

In an observational study by Al Wakeel et al. [28], patients undergoing peritoneal dialysis experienced no severe morbidity or deterioration in the renal function during Ramadan fasting, while hypotension and lower-extremity edema occurred in a few patients. The mentioned study also implied that most of the stable patients on peritoneal dialysis could fast during Ramadan with the close monitoring of fluid and electrolyte balances [28]. Furthermore, patients receiving regular hemodialysis may be able to fast during Ramadan under medical supervision as indicated by a prospective cohort study in Malaysia [29], a longitudinal study in Pakistan [30], a prospective, multicenter, observational, cross-sectional study in Saudi Arabia [31], a prospective, multicenter, observational study in Malaysia [32], a prospective cohort study in Palestine [33], and a multicenter observational study in Egypt [34].

The longitudinal study by Imtiaz et al. [30] showed that serum albumin increased significantly, while no significant changes were observed in other parameters, such as the body weight, blood pressure, serum potassium, and serum phosphorus, in the patients undergoing maintenance dialysis during Ramadan fasting. On the other hand, Alshamsi et al. [31] reported that the hemodialysis patients observing Ramadan fasting had significantly higher serum phosphorous, while no changes were observed in other parameters, such as the blood pressure, serum potassium, albumin, and body weight. According to the findings of Khazneh et al. [33], body weight and serum potassium increased in

the patients undergoing hemodialysis during Ramadan fasting.

A 24-year retrospective study conducted in this regard in Pakistan indicated that the mortality rate was higher among hemodialysis patients

during Ramadan compared to other months [35]. Therefore, the patients receiving dialysis who are willing to fast during Ramadan should be monitored closely.

Table 1. Impact of Ramadan Fasting on Renal Diseases

Renal Diseases	Author(s)	Outcomes
Chronic Kidney Disease (CKD)	Chowdhury et al. [14]	No significant changes in weight, blood pressure, creatinine, glycated haemoglobin (HbA1C), cholesterol and urinary protein-creatinine ratio (PCR) due to Ramadan fasting.
	Hassan et al. [16]	Significant elevation of serum urea levels and reduction of hydration status indices and plasma BNP levels which returned to normal after 4 weeks.
	Kara et al. [17]	Serum creatinine was elevated and estimated glomerular filtration rate (eGFR) was lowered in nonfasting patients with CKD compared to the CKD patients on Ramadan fasting.
	Bernieh et al. [18]	Reduction in the mean of body weight, systolic and diastolic blood pressure, triglycerides, and urinary protein excretion and an improvement in eGFR of patients with CKD who fasted during Ramadan.
	NasrAllah et al. [19]	Use of renin angiotensin aldosterone system (RAAS) blockers and diuretics were associated with increased serum creatinine at day 7 of fasting in CKD patients observing Ramadan fasting.
	Bakhit et al. [20]	Ramadan fasting in patients with CKD resulted in elevated creatinine levels, improvement in mean systolic blood pressure, significant reduction of HbA1c and improved diabetic control.
Renal Colic	Miladipour et al. [22]	Significant reduction of total excretion of calcium, phosphate, and magnesium in 24-hour urine and urine volume, significantly higher urine concentrations of uric acid, citrate, phosphate, sodium, and potassium and no significant increase in calcium oxalate supersaturation were noted in men observing Ramadan fasting.
	Cevik et al. [23]	Ramadan fasting in patients with renal colic induced significant changes in some parameters such as hemoglobin, general crystal, and triple phosphate crystal values.
	Basiri et al. [24]	The frequency of admissions due to renal colic was significantly higher in warm seasons and no significant difference in colder months in comparison with Ramadan.
	Al Mahayni et al. [25]	The rate of urinary tract stones was higher in those over 40 years old and most of the urinary tract stones were formed in the ureter.
	Abdolreza et al. [27] and Sagy et al. [26]	Hospital admissions due to renal colic were significantly higher during the first two weeks of Ramadan.
	Sagy et al. [26]	The emergency department (ED) visits with renal colic was higher during summer and 2–4% in ED visits were increased for every increase in 1 °C.
Dialysis	Al Wakeel et al. [28]	The patients undergoing peritoneal dialysis did not experience any serious morbidity or deterioration in renal function during Ramadan fasting though hypotension and lower limb edema occurred in few patients. The study implied that most stable patients on peritoneal dialysis could fast during Ramadan with close monitoring of fluid and electrolyte balances.
	Imtiaz et al. [30]	The serum albumin has been increased significantly and no significant changes seen in other parameters like body weight, blood pressure, serum potassium, and serum phosphorus in patients who were on maintenance dialysis during Ramadan fasting.
	Alshamsi et al. [31]	The hemodialysis patients observing Ramadan fasting shown a significantly higher serum phosphorous while no changes in other parameters such as blood pressure; serum potassium, albumin and body weight.
	Khazneh et al. [33]	Body weight and serum potassium have been increased in patients undergoing hemodialysis during Ramadan fasting.
	Imtiaz S et al. [35]	The frequency of death among hemodialysis patients during Ramadan was higher compared to other months
Kidney transplant recipients	Bernieh et al. [36]	Significant elevation of serum levels of potassium in the recipients of kidney transplants during Ramadan fasting.
	Abdalla et al. [37]	No statistical changes in urinary and serum biochemical parameters and hematocrit in the recipients of kidney transplants during Ramadan fasting.
	Qurashi et al. [38]	No significant differences in serum creatinine and estimated glomerular filtration rate of the kidney transplants recipients during Ramadan fasting.
	Boobes Y et al. [40]	No significant changes in body weight, blood pressure, kidney function tests, blood sugar, lipid profile, and cyclosporine levels of the kidney transplants recipients during Ramadan fasting.
	Einollahi et al. [42]	No significant changes in estimated GFR, Creatinine clearance and other parameters like body weight, blood pressure, serum levels of blood urea nitrogen, creatinine, uric acid, blood glucose, electrolytes, lipids and hemoglobin of the kidney transplants recipients during Ramadan fasting.
	Salem et al. [43]	No changes in the parameters like body weight, blood pressure, cyclosporine level, urine volume, mean serum levels of urea and creatinine and mean creatinine clearance of the kidney transplants recipients during Ramadan fasting.

Ramadan Fasting and Kidney Transplant Recipients

The recipients of kidney transplant may fast safely during Ramadan as indicated by the prospective studies performed in Saudi Arabia [36-39], United Arab Emirates [40], Iran [41, 42], and Libya [43], as well as a retrospective cohort study in Saudi Arabia [44]. The study by Bernieh et al. [36] demonstrated the significant elevation of the serum levels of potassium in the recipients of kidney transplant during Ramadan fasting. Conversely, Abdalla et al. [37] observed no significant changes in the urinary and serum biochemical parameters and hematocrit in the recipients of kidney transplant during Ramadan fasting.

The findings of Qurashi et al. [38] showed no significant differences in the serum creatinine and eGFR of kidney transplant recipients during Ramadan fasting, while Boobes Y et al. [40] reported no significant changes in the body weight, blood pressure, kidney function tests, blood glucose, lipid profile, and cyclosporine levels of kidney transplant recipients during Ramadan fasting. Similarly, the study by Einollahi et al. [42] showed no significant changes in the eGFR, creatinine clearance, and other parameters (e.g., body weight, blood pressure, serum levels of blood urea nitrogen, creatinine, uric acid, blood glucose, electrolytes, lipids, and hemoglobin) in kidney transplant recipients during Ramadan fasting. Salem et al. [43] reported no significant changes in parameters such as the body weight, blood pressure, cyclosporine level, urine volume, mean serum levels of urea and creatinine, and mean creatinine clearance in kidney transplants recipients during Ramadan fasting.

The month-long fasting during Ramadan in patients with renal disorders (e.g., CKD, renal colic, dialysis) and kidney transplant recipients might be safer as several studies have confirmed no deterioration of renal functions (Table 1). Patients with renal disorders have mainly been advised to drink adequate quantities of water and other fluids and take their medicines regularly based on the physician's recommendations during their non-fasting hours in order to prevent adverse outcomes.

Recommendations for the Patients with Renal Disorders Willing to Fast

Although Ramadan fasting is not obligatory for ill individuals, menstruating, pregnant, and breastfeeding women, the elderly, and travelers [45], patients with CKD may be willing to fast during Ramadan and should consult their healthcare professionals before, during, and after Ramadan in order to fast under close medical supervision [46]. Furthermore, the patients with renal colic who are willing to fast during Ramadan should be advised to consume adequate water during non-fasting hours to reduce the potential risk of dehydration [47]. Patients with renal disorders should not skip Sahur (pre-dawn meal) as they need more calories during the fasting period [48] and should limit the intake of the foods that are rich in sodium, potassium, and phosphorus (e.g., dates, apricots, fried foods, nuts, cheese, soft juices and drinks, tea, and coffee) [49]. Moreover, they should avoid being outside in high temperatures in order to prevent dehydration. Patients with renal disorders are advised to drink adequate quantities of water and other fluids while fasting [50] and take their medicines regularly based on the physician's recommendations during non-fasting hours. Most importantly, these patients should be advised to recognize alarming symptoms such as weakness, facial swelling, and shortness of breath, dizziness, and anorexia and seek immediate medical attention [28].

Conclusion

Although ill individuals are exempted from Ramadan fasting, the majority of patients with renal disorders may prefer fasting during Ramadan. The absence of fluid intake during Ramadan fasting leads to dehydration, which may affect the renal health. To prevent the associated complications, patients with CKD are advised to consult their healthcare professionals before, during, and after Ramadan and fast under close medical supervision. In addition, the patients with renal colic who are willing to fast during Ramadan should be advised to consume adequate water during non-fasting hours to reduce the potential risk of dehydration. In general, patients with renal disorders are advised to drink adequate quantities of water and other fluids and take their medicines regularly based on the physician's recommendations during non-fasting hours. In conclusion, patients with renal disorders are able

to fast safely during Ramadan under medical supervision.

Conflicts of interest

None declared.

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