

IS RAMADAN FASTING SAFE FOR CARDIOVASCULAR, DIABETIC AND CHRONIC KIDNEY DISEASE PATIENTS? A MINI SYSTEMATIC REVIEW

SHAKEEL AHMAD

Department of Nutrition and Food Hygiene, School of Public Health, Nanjing Medical University, Nanjing 211166, China.

UMAR FAROOQ

Department of Nutrition and Dietetics, National University of Medical Sciences, Rawalpindi, Pakistan.

SALAH UDDIN

Department of Human Nutrition, The University of Agriculture, Peshawar, Pakistan.

SAJEELA AKRAM

Department of Human Nutrition and Dietetics, University of Chakwal, Pakistan.

MADIHA GHAZANFAR

Department of Diet and Nutritional Sciences, Ibadat International University, Islamabad, Pakistan.

ABDUL MOMIN RIZWAN AHMAD

Department of Nutrition and Dietetics, National University of Medical Sciences, Rawalpindi, Pakistan.

JUWERIA ABID*

Department of Nutrition and Dietetics, National University of Medical Sciences, Rawalpindi, Pakistan.
Corresponding Author Email: Juweria.abid@numspak.edu.pk

Abstract

Background and aims; Ramadan is one of the five pillars of the Islamic religion. Fasting in the month of Ramadan is obligatory for all healthy adults Muslims. The physicians, as well as religious authorities strictly prohibit Muslim patients from fasting during the month of Ramadan. Regardless of exemption from this religious duty, some Muslim patients prefer fasting. The studies conducted on the effects of Ramadan fasting on cardiovascular disease, diabetes and chronic kidney disease and its safety are inconsistent; that's why this review was aimed to evaluate whether Ramadan fasting is safe for them or not? **Methods;** A thorough search was done on electronic databases like Google Scholar, Embase, Scopus, MEDLINE, Web of Science and Global health. Relevant articles were included in this study. The randomized and non-randomized trials, observational studies like case-control, cohort, and cross-sectional studies conducted between 2009 and 2020 were included in this review. **Results;** based on the available literature, Ramadan fasting plays an important role in regulating human health. Fasting is not only beneficial for healthy individuals but for diseased individuals as well. Ramadan fasting significantly improves blood pressure, biomarkers of cardiometabolic risk, regulate inflammation, reduces weight, glycemic control and improves lipid profile. It has a positive impact on both type 1 and type 2 diabetes. Educating diabetic patients before the month of Ramadan can significantly reduce severe hyperglycemia and hypoglycemia. Grade 2-4 chronic kidney patients have no significant deterioration in the renal function who fast for the whole month of Ramadan. **Conclusion;** Available evidence suggest that Ramadan fasting may be safe for high-risk population i-e cardiovascular, diabetes and chronic kidney disease patients. However, for any definitive conclusions, more robust trials are required.

Highlights

- Ramadan fasting significantly improves cardiovascular health.
- Ramadan has a positive impact on both type 1 and type 2 diabetes.
- Grade 2-4 CKD patients can keep fast for the whole month of Ramadan without any harm.

1. INTRODUCTION

Ramadan is one of the five pillars of the Islamic religion. Fasting in the month of Ramadan is obligatory for all healthy Muslim adults [1]. About >1.6 billion Muslims around the world fast in 9th month of each lunar year [2]. During fasting, Muslims abstain from drinking, eating, smoking and sexual activities from pre-dawn to sunset. They are motivated to increase prayers offering and keep themselves away from sinful activities to focus on the basic essential of life [3]. The time period of fast in Ramadan varies from region to region and from season to season with an average 12 hours of length (range 11-20 hours). As the solar year is 11 days longer than the lunar year, Ramadan rotates in all four seasons [4]. Muslim children, elderly, sick individuals (who are unable to fast) and travelers are exempted from fasting during the month of Ramadan [5]. Traveeh, a special prayer each night is performed during this month. The changes in the frequency of meal, times of meals and offering prayers modify the sleep/wake-up cycle, thus may influence the health of the fasting individuals [6].

Ramadan fasting is considered a type of intermittent fasting or caloric restricted feeding [7]. Evidence from literature shows that Ramadan fasting is related to reduction in body weight [8], total body fat mass [9] and serum lipid level [10]. Ramadan also increases immune-modulatory functions [11] and improves biomarkers of inflammation and oxidative stress in the body [12–14]. Other studies also confirmed the effect of Ramadan fasting to improve many cardiometabolic risk factors, including blood pressure, insulin sensitivity, serum HDL, LDL, triglyceride and total cholesterol levels [9, 12, and 15]. A randomized clinical trial confirmed that inflammatory biomarkers like serum levels of adiponectin, IL-6, TNF- α , and IGF-1 significantly decreased at the end of Ramadan [16].

Evidence from literature shows that Ramadan fasting has a positive impact on both type 1 and type 2 diabetes. Type 1 diabetes patients who used continuous subcutaneous insulin infusions and subjected to fasting has reduced frequencies of severe hyperglycemia, hypoglycemia and ketosis during Ramadan [17]. A study conducted on the effect of Ramadan fasting on type 2 diabetic patients revealed that mean weight, mean triglyceride and mean blood pressure were decreased significantly, which confirms the safety of fasting for patients with type 2 diabetes during Ramadan [18]. Some studies revealed that diabetic patients, even with higher risk, insist on fasting, and they can do so with no major hypoglycemic events [19, 20]. Furthermore, pre-Ramadan education programs for diabetic patients have a significant role in safer fasting during Ramadan [21]. Understanding religious obligations and the medical aspects of Ramadan fasting are essential through full collaboration between diabetic patients and health care professionals [22, 23].

Recent literature reveals that Ramadan fasting significantly improves blood pressure, biomarkers of cardiometabolic risk, regulate inflammation, reduce weight, glycemic control and improves lipid profile [24, 25]. Similarly, it significantly reduces the frequency of arterial arrhythmia and lowers the cholesterol level among heart failure patients [26]. Heart patients who keep fasting have less likelihood of ischemic cardiomyopathy during the month of Ramadan as compared to non-Ramadan days [27]. Heart rate variability as an independent risk factor of increased mortality among congestive heart failure and myocardial infarction patients decreases significantly during the month of Ramadan [28]. It significantly lowers the incidence of heart failure among previously myocardial infarction patients and reduces the incidence of hospitalization among acute coronary syndrome patients [15]. A meta-analysis confirmed that Ramadan fasting has no negative effect on cardiovascular events, including myocardial infarction, congestive heart failure and stroke [29]. Hence Ramadan fasting is a healthy non-medicinal way of improving cardiovascular diseases [30].

Some studies have investigated that Ramadan fasting positively affects patients with a kidney transplant or chronic kidney disease by improving glomerular filtration rate and reducing proteinuria [31, 32]. Ramadan fasting does not deteriorate renal function, nor it significantly increases cardiovascular events or hospitalization [33]. Similarly, a study concluded that grade 2-4 chronic kidney patients have no significant deterioration in the renal function who fast for the whole month of Ramadan [34]. Another study conducted on the effects of Ramadan fasting on hemodialysis patients revealed that 14 hours fasting for one month has no adverse effect on their health [35]. Likewise, it is also established that chronic kidney disease patients who fasted for the whole month of Ramadan reduced their body weight as well as systolic and diastolic blood pressure [32].

2. Rational of this review

The physicians, as well as religious authorities strictly prohibit Muslim patients from fasting during the month of Ramadan. Regardless of exemption from this religious duty, some Muslim patients prefer fasting [5, 36, 37]. The studies conducted on the effects of Ramadan fasting on cardiovascular disease and its associated factors are inconsistent. Fasting has been observed to have both negative and positive impacts on cardiovascular disease and cardiometabolic risk factors [3, 38–40]. Similarly, controversial results are found on the effect of Ramadan fasting on type 1 and type 2 diabetes. Some studies observed an increase in hypoglycemia in both type 1 and type 2 diabetes, while other studies indicated otherwise [41, 42]. Some studies noticed a reduction in both hypoglycemia and hyperglycemia and considered Ramadan fasting safe for diabetic patients [43–45]. Likewise, there are conflicting data regarding Ramadan fasting and its impact on chronic kidney disease patients. Some studies established that fasting reduces proteinuria and improves glomerular filtration rate (eGFR) [31, 32], where other studies showed a negative impact on chronic kidney disease and kidney transplant patients [46–48]. Therefore, this review was designed to evaluate the effect of Ramadan fasting on

cardiovascular, diabetic and chronic kidney disease patients and draw a fine conclusion either Ramadan fasting is safe for these patients or not?

3. METHODS AND DATA SELECTION

A thorough search was done on electronic databases like Google Scholar, Embase, Scopus, MEDLINE, and Web of Science and Global health. All possible resources were utilized to retrieve full articles. Different searches were used in combination with Ramadan and cardiovascular/diabetes/chronic kidney disease, fasting and cardiovascular/diabetes/chronic kidney disease, the effect of Ramadan fasting on cardiovascular/diabetes/chronic kidney disease, Safety of Ramadan fasting on cardiovascular/diabetes/chronic kidney disease, the health status of cardiovascular/diabetes/chronic kidney disease during Ramadan fasting. Related references were cited in each study also manually looked through. The randomized and non-randomized trials, observational studies like case-control, cohort, and cross-sectional studies conducted between 2009 and 2020 were included in this review. All other retrospective studies and expert opinion were excluded in this study.

4. RAMADAN FASTING IN THE HIGH-RISK POPULATION

We have selected all the studies based on inclusion criteria that assessed cardiovascular, diabetic and chronic kidney disease patients. The results drawn from these studies are explained below.

4.1 The effect of Ramadan fasting on cardiovascular disease

There are many dietary interventions that have proved to enhance cardiovascular health, including Ramadan intermittent fasting, which involves consumption of food for a certain period of time during 24 hours day cycle. Ramadan fasting is linked to improving body weight, blood pressure and insulin sensitivity [49]. Another study showed that Ramadan fasting improves health-related biomarkers, maintain muscle mass and decrease fat mass in humans [50]. Likewise, a study conducted on the effects of fasting on obese women revealed that intermittent fasting reduces body weight as well as chances of cardiovascular events [51]. Evidence from several studies has proved that weight loss due to intermittent fasting can reduce both systolic and diastolic blood pressure [52–55]. With respect to total cholesterol level, the evidence is contradictory. Many studies reported that intermittent fasting reduces total cholesterol [52,56]; on the other hand, studies showed no significant effect [52,57,58]. Recently, a study observed that fasting improves cardiovascular health by reducing pulse wave velocity, pulse pressure, arterial pressure, heart rate and blood pressure. The findings conclude that these changes might decrease the risk of cardiovascular events [59]. Meta-analysis of 15 studies concluded that intermittent fasting reduces body fat and BMI significantly, while body weight, waist circumference, total cholesterol, triglyceride, blood glucose and insulin level, systolic and diastolic blood pressure decrease non-significantly [60].

Fasting brings changes in biomarkers of cardiovascular, metabolic and general health; thus, periodic fasting significantly reduces the risk of metabolic disease [61]. Recently a study conducted on the effect of fasting and non-fasting on the incident of coronary events revealed that there is no significant difference between fasting and non-fasting groups [61]. Meanwhile, another study found that fasting reduces the incidence of cardiovascular events by promoting cardiac efficiency [62, 63]. It improves cardiac hypertrophy caused by pressure overload and suppresses cardiac oxidative injury to improve diastolic function [64]. Similarly, it regulates visceral fat and adipocytes and protects against coronary heart disease [65].

4.2 The effects of Ramadan fasting on diabetes

People with a chronic disease like diabetes are exempted from the duty of fasting in Islam, but still, some people insist on observing fast, which increases the risk of complications [36, 37]. As diabetes is concerned, daytime hypoglycemic events and increase hospitalization are more prominent during Ramadan fasting [66, 67]. Ramadan and diabetes guideline are accepted worldwide, and all experts agreed that diabetic patients at high risk of hypoglycemia should not keep fast during Ramadan [20, 68, 69]; this decision is supported by religious scholars as well [22]. Even knowing the increased risk for complications, some patients observe fast while going against medical advice [70]. Even fasting is well tolerated by many diabetic patients. However, type 1 diabetes and type 2 diabetes with multiple injectable daily insulins may lead to certain conditions like hyperglycemia, hypoglycemia and ketogenesis [41, 71].

A study showed that educating diabetic patients before the month of Ramadan can significantly reduce severe hyperglycemia and hypoglycemia [72, 73]. Similar results were found in another study conducted in Bangladesh among diabetic children [44]. Reducing insulin by 20%, proper education and self-management can decrease the risk of hypoglycemia in insulin-dependent diabetic patients, and they can safely keep fast without any hospitalization [45, 74]. Despite fluctuations in glycaemia, it is found that patients with type 1 diabetes can fast for a maximum of days of Ramadan without any emergency visits to health care units [75]. Compared to the control group, diabetic type 2 patients on a single daily dose of insulin glargine and three times repaglinide had no significant increase in hypoglycemic events [76, 77]. Kalra et al. elevated the use of insulin IDegAsp versus degludec in diabetic patients concluded that both regimes could be safely used in Ramadan without any adverse event [78]. A recent trial conducted by Bashier et al. evaluated the safety of fasting among insulin-dependent type 2 diabetic patients, who used flash glucose monitoring had no adverse events of hypoglycemia nor metabolic and biometric parameters [79]. Most of the studies carried out on gestational diabetes confirmed that Ramadan fasting has no significant adverse glycemic effects, while different results are obtained on maternal and fetal outcomes in healthy pregnant women [80–82].

4.3 The effect of Ramadan fasting on chronic kidney disease

The prevalence of chronic kidney disease (CKD) is rising world widely [83]. CKD is associated with a number of comorbidities, including diabetes, hypertension, acquired immune deficiency syndrome (AIDS), cardiovascular disease and malaria, which has impact on global morbidity and mortality [84]. There are clear instructions from medical professionals and religious authorities regarding the exemption of fasting for sick people, yet there is a significant number of CKD patients who decide to fast during the month of Ramadan [20]. Very few studies are conducted on the effect of Ramadan fasting on CKD, and inconsistent results are achieved [32, 35, 85]. Results of 2 studies showed that Ramadan fasting improves systolic and diastolic blood pressure in CKD patients [32,86]. The effects of Ramadan fasting on electrolytes are variable, but it is established that fasting can cause hyperkalemia [85]. A study conducted on CKD stage 3 and advanced stages revealed that fasting could worsen kidney function by raising the creatinine level [87]. Other published studies oppose the side effects of Ramadan fast on CKD. No significant changes were found by Hassan et al. in eGFR and hydration level before and after Ramadan fasting [34]. Turkish study compared non-fasting CKD patients with fasting CKD patients; no significant changes in kidney function were noticed between them [88]. CKD stage 3 patients observed 19 hours fasting in Ramadan, and the results found no significant difference in adverse events, including acute kidney injury between fasting and non-fasting groups [89].

A study conducted in patients on peritoneal dialysis showed that Ramadan fasting could cause minor adverse events (peritonitis, pleural effusion and fluid overload) while no major adverse events were noticed in that study [90], provided that they strictly adhere to their medications and dialysis therapy in addition to the dietary restrictions. Interestingly, a study observed improvements in serum phosphorus, albumin and diastolic blood pressure in fasting hemodialysis patients as compared to non-fasting patients [91]. Similar results with a reduction in body weight in chronic hemodialysis patients were assessed by another study conducted in Malaysia [92]. On the other hand, a multicenter study conducted in Saudi Arabia observed no such changes [93]. Subsequently, hemodialysis patients who fasted more than 20 days have improved body weight, body mass index (BMI), and serum albumin, urea, and creatinine level during the month of Ramadan [94].

Iranian study revealed that Ramadan fasting has no significant effect on creatinine level among kidney transplant patients [95]. Another study conducted on 22 kidney transplant patients who kept fast showed no difference in tacrolimus or ciclosporin levels before, during and after the month of Ramadan [96]. Serum creatinine and eGFR level were found similar in kidney transplant patients before and after Ramadan in 2 different studies conducted in Saudi Arabia [97, 98]. Similar results were obtained from another study [99]. Kidney patients who were transplanted more than an average 8.5 years ago, upon fasting they had stable serum creatinine, renal function, blood pressure, and body weight and urine volume compared to their non-fasting counterparts [100].

Table 1. Categories of risk in patients with diabetes, CKD, and CVD who fast during Ramadan
<p>Very high risk (MUST NOT fast) One or more of the following:</p> <ul style="list-style-type: none">• Severe hypoglycemia within the three months before Ramadan.• Unexplained DKA within the three months before Ramadan.• Hyperosmolar hyperglycemic coma within the three months before Ramadan.• History of recurrent hypoglycemia.• History of hypoglycemic unawareness.• Poorly controlled T1DM.• Acute illness.• Pregnancy in pre-existing diabetes or GDM treated with insulin or SUs.• Chronic dialysis or CKD, stage 4 & 5.• Advanced macrovascular complications.• Old age with ill health. <p>High risk (Should NOT fast) One or more of the following:</p> <ul style="list-style-type: none">• T2DM with sustained poor glycemic control.• Well-controlled T1DM.• Well-controlled T2DM on MDI or mixed insulin.• Pregnant T2DM or GDM is controlled by diet only or metformin.• CKD, stage 3.• Stable macrovascular complications.• Patients with comorbid conditions that present additional risk factors.• People with diabetes performing intense physical labor.• Treatment with drugs that may affect cognitive function. <p>Moderate risk (Decision to use a license not to fast based on the discretion of medical opinion and ability of the individual to tolerate fast) Well-controlled T2DM treated with one or more of the following:</p> <ul style="list-style-type: none">• Lifestyle therapy.• Metformin.• Acarbose.• Thiazolidinediones.• Second-generation SUs.• Incretin-based therapy (DPP-4 inhibitors or GLP-1 RAs).• SGLT2 inhibitors.• Basal insulin. <p>From Recommendations for Management of Diabetes During Ramadan Update 2020 Diabetes Research and Clinical Practice.</p>

5. CONCLUSION

Based on the above literature, Ramadan fasting has a vital role in regulating human health. Fasting is not only beneficial for healthy individuals but diseased individuals as well. Ramadan fasting significantly improves blood pressure, biomarkers of cardiometabolic risk, regulate inflammation, reduce weight, glycemic control and improves lipid profile. It has a positive impact on both type 1 and type 2 diabetes. Educating diabetic patients before the month of Ramadan can significantly reduce severe hyperglycemia and hypoglycemia. Grade 2-4 chronic kidney patients have no significant

deterioration in the renal function who fast for the whole month of Ramadan. Available evidence suggests that Ramadan fasting may be safe for high-risk population i.e cardiovascular, diabetes and chronic kidney disease patients. However, for any definitive conclusions, more robust trials are required.

Acknowledgements

Thank you, Prof Qing Feng and Muhammad Naveed, Nanjing Medical University, for their valuable suggestions.

Funding

The authors received no funding from an external source.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] Lauche R, Fathi I, Saddat C, Klose P, Al-Abtah J, Büssing A, et al. The effects of Ramadan fasting on physical and mental health in healthy adult Muslims—Study protocol for a randomized controlled trial. *Adv Integr Med* 2016; 3:26–30. <https://doi.org/10.1016/j.aimed.2016.07.001>.
- [2] Hassanein M, Al-Arouj M, Hamdy O, Bebakar WMW, Jabbar A, Al-Madani A, et al. Diabetes and Ramadan: Practical guidelines. *Diabetes Res Clin Pract* 2017; 126:303–16. <https://doi.org/10.1016/j.diabres.2017.03.003>.
- [3] Trepanowski JF, Bloomer RJ. The impact of religious fasting on human health. *Nutr J* 2010; 9:57. <https://doi.org/10.1186/1475-2891-9-57>.
- [4] Bakhotmah B. The puzzle of self-reported weight gain in a month of fasting (Ramadan) among a cohort of Saudi families in Jeddah, Western Saudi Arabia. *Nutr J* 2011; 10:84. <https://doi.org/10.1186/1475-2891-10-84>.
- [5] Al Hourani H, Atoum M, Akel S, Hijjawi N, Awawdeh S. Effects of Ramadan fasting on some haematological and biochemical parameters. *Jordan J Biol Sci* 2009; 2:103–8.
- [6] Khan N, Rasheed A, Ahmed H, Aslam F, Kanwal F. Effect of ramadan fasting on glucose level, lipid profile, HbA1c and uric acid among medical students in Karachi, Pakistan. *East Mediterr Heal J* 2017; 23:274–9. <https://doi.org/10.26719/2017.23.4.274>.
- [7] Patterson RE, Sears DD. Metabolic Effects of Intermittent Fasting. *Annu Rev Nutr* 2017; 37:371–93.
- [8] Sadeghirad B, Motaghipisheh S, Kollahdooz F, Zahedi MJ, Haghdoost AA. Islamic fasting and weight loss: A systematic review and meta-analysis. *Public Health Nutr* 2014; 17:396–406. <https://doi.org/10.1017/S1368980012005046>.
- [9] Mazidi M, Rezaie P, Chaudhri O, Karimi E, Nematy M. The effect of Ramadan fasting on cardiometabolic risk factors and anthropometrics parameters: A systematic review. *Pakistan J Med Sci* 2015; 31:1250–5.
- [10] Kul S, Savaş E, Öztürk ZA, Karadağ G. Does Ramadan Fasting Alter Body Weight and Blood Lipids and Fasting Blood Glucose in a Healthy Population? A Meta-analysis. *J Relig Health* 2014; 53:929–42. <https://doi.org/10.1007/s10943-013-9687-0>.

- [11] Adawi M, Watad A, Brown S, Aazza K, Aazza H, Zouhir M, et al. Ramadan fasting exerts immunomodulatory effects: Insights from a systematic review. *Front Immunol* 2017; 8. <https://doi.org/10.3389/fimmu.2017.01144>.
- [12] Faris MAIE, Hussein RN, Al-Kurd RA, Al-Fararjeh MA, Bustanji YK, Mohammad MK. Impact of ramadan intermittent fasting on oxidative stress measured by urinary 15- F 2t -isoprostane. *J Nutr Metab* 2012; 22:1–9. <https://doi.org/10.1155/2012/802924>.
- [13] Faris MAIE, Kacimi S, Al-Kurd RA, Fararjeh MA, Bustanji YK, Mohammad MK, et al. intermittent fasting during Ramadan attenuates proinflammatory cytokines and immune cells in healthy subjects. *Nutr Res* 2012; 32:947–55. <https://doi.org/10.1016/j.nutres.2012.06.021>.
- [14] Faris MAIE, Jahrami HA, Obaideen AA, Madkour MI. Impact of diurnal intermittent fasting during Ramadan on inflammatory and oxidative stress markers in healthy people: Systematic review and meta-analysis. *J Nutr Intermed Metab* 2019; 15:18–26. <https://doi.org/10.1016/j.jnim.2018.11.005>.
- [15] Salim I, Al Suwaidi J, Ghabban W, Alkilani H, and Salam AM. Impact of religious Ramadan fasting on cardiovascular disease: A systematic review of the literature. *Curr Med Res Opin* 2013; 29:343–54. <https://doi.org/10.1185/03007995.2013.774270>.
- [16] Faris MAIE, Madkour MI, Obaideen AK, Dalah EZ, Hasan HA, Radwan H, et al. Effect of Ramadan diurnal fasting on visceral adiposity and serum adipokines in overweight and obese individuals. *Diabetes Res Clin Pract* 2019; 153:166–75. <https://doi.org/10.1016/j.diabres.2019.05.023>.
- [17] Loh HH, Lim LL, Loh HS, Yee A. Safety of Ramadan fasting in young patients with type 1 diabetes: A systematic review and meta-analysis. *J Diabetes Investig* 2019; 10:1490–501. <https://doi.org/10.1111/jdi.13054>.
- [18] Khan N, Khan MH, Zaman Shaikh M, Khanani MR, Rasheed A. Effects of ramadan fasting and physical activity on glucose levels and serum lipid profile among type 2 diabetic patients. *Pakistan J Med Sci* 2012; 28:91–6. <https://doi.org/10.12669/pjms.281.1712>.
- [19] Ibrahim M, Abu Al Magd M, Annabi FA, Assaad-Khalil S, Ba-Essa EM, Fahdil I, et al. Recommendations for management of diabetes during Ramadan: Update 2015. *BMJ Open Diabetes Res Care* 2015; 3:1–9. <https://doi.org/10.1136/bmjdcrc-2015-000108>.
- [20] Hassanein M, Al-Arouj M, Hamdy O, Bebakar WMW, Jabbar A, Al-Madani A, et al. Diabetes and Ramadan: Practical guidelines. *Diabetes Res Clin Pract* 2017; 126:303–16. <https://doi.org/10.1016/j.diabres.2017.03.003>.
- [21] Mustafa H, Hashim T, Beshyah S, Amin R, Eissa R, Tommy M, et al. “Targeted diabetes education” and glycemic control during ramadan fasting: An exploratory study. *Ibnosina J Med Biomed Sci* 2012; 4:242. <https://doi.org/10.4103/1947-489x.210781>.
- [22] Beshyah S. Fasting during the month of ramadan for people with diabetes: Medicine and fiqh united at last. *Ibnosina J Med Biomed Sci* 2009; 1:58. <https://doi.org/10.4103/1947-489x.211054>.
- [23] International Islamic Fiqh Academy. Decree Number 183 (9/19) concerning diabetes and Ramadan fasting. IIFA’s council 19th session. *Int Islam Fiqh Acad* 2009.
- [24] Alam I, Gul R, Chong J, Tan CTY, Chin HX, Wong G, et al. Recurrent circadian fasting (RCF) improves blood pressure, biomarkers of cardiometabolic risk and regulates inflammation in men. *J Transl Med* 2019; 17. <https://doi.org/10.1186/s12967-019-2007-z>.
- [25] BaHammam AS, Almeneessier AS. Recent Evidence on the Impact of Ramadan Diurnal Intermittent Fasting, Mealtime, and Circadian Rhythm on Cardiometabolic Risk: A Review. *Front Nutr* 2020; 7. <https://doi.org/10.3389/fnut.2020.00028>.

- [26] Salam AM, Sulaiman K, Alsheikh-Ali AA, Singh R, Asaad N, Al-Qahtani A, et al. Acute heart failure presentations and outcomes during the fasting month of Ramadan: an observational report from seven Middle Eastern countries. *Curr Med Res Opin* 2018; 34:237–45. <https://doi.org/10.1080/03007995.2017.1376629>.
- [27] Abazid RM, Khalaf HH, Sakr HI, Altorbak NA, Alenzi HS, Awad ZM, et al. Effects of ramadan fasting on the symptoms of chronic heart failure. *Saudi Med J* 2018; 39:395–400. <https://doi.org/10.15537/smj.2018.4.22011>.
- [28] Mzoughi K, Zairi I, Jabeur M, Kraiem S. The effects of fasting on heart rate variability in hypertensive patients. *Clin Exp Hypertens* 2018; 40:793–6. <https://doi.org/10.1080/10641963.2018.1433194>.
- [29] Turin T, Ahmed S, Shommu N, Afzal A, Al Mamun M, Qasqas M, et al. Ramadan fasting is not usually associated with the risk of cardiovascular events: A systematic review and meta-analysis. *J Fam Community Med* 2016; 23:73. <https://doi.org/10.4103/2230-8229.181006>.
- [30] Chamsi-Pasha M, Chamsi-Pasha H. The cardiac patient in Ramadan. *Avicenna J Med* 2016; 6:33. <https://doi.org/10.4103/2231-0770.179547>.
- [31] Bragazzi NL. Ramadan fasting and chronic kidney disease: Does estimated glomerular filtration rate change after and before Ramadan? Insights from a mini meta-analysis. *Int J Nephrol Renovasc Dis* 2015; 8:53–7. <https://doi.org/10.2147/IJNRD.S61718>.
- [32] Bernieh B, Mohammad Raafat AH, Yousef B, Fikri M. Abu Z. Fasting Ramadan in Chronic Kidney Disease Patients: Clinical and Biochemical Effects. *Saudi J Kidney Dis Transplant* 2010; 21:898–902. <https://doi.org/10.2337/db06-1293.Additional>.
- [33] Chowdhury A, Khan H, Lasker SS, Chowdhury TA. Fasting outcomes in people with diabetes and chronic kidney disease in East London during Ramadan 2018: The East London diabetes in Ramadan survey. *Diabetes Res Clin Pract* 2019; 152:166–70. <https://doi.org/10.1016/j.diabres.2019.05.022>.
- [34] Hassan S, Hassan F, Abbas N, Hassan K, Khatib N, Edgim R, et al. Does Ramadan Fasting Affect Hydration Status and Kidney Function in CKD Patients? *Ann Nutr Metab* 2018; 72:241–7. <https://doi.org/10.1159/000486799>.
- [35] Wakeel JS Al. Kidney function and metabolic profile of chronic kidney disease and hemodialysis patients during ramadan fasting. *Iran J Kidney Dis* 2014; 8:430–2.
- [36] Salti I, Bénard E, Detournay B, Bianchi-Biscay M, Le Brigand C, Voinet C, et al. A population-based study of diabetes and its characteristics during the fasting month of ramadan in 13 countries: Results of the epidemiology of diabetes and ramadan 1422/2001 (EPIDIAR) study. *Diabetes Care* 2004; 27:2306–11. <https://doi.org/10.2337/diacare.27.10.2306>.
- [37] Babineaux SM, Toaima D, Boye KS, Zagar A, Tahbaz A, Jabbar A, et al. Multi-country retrospective observational study of the management and outcomes of patients with Type 2 diabetes during Ramadan in 2010 (CREED). *Diabet Med* 2015; 32:819–28. <https://doi.org/10.1111/dme.12685>.
- [38] Mazidi M, Karimi E, Rezaee P, Nematy M, Salehi M. The effects of ramadan fasting on body composition. *Shiraz E Med J* 2014; 15:1–4. <https://doi.org/10.17795/semj19733>.
- [39] Hussain SM, Oldenburg B, Wang Y, Zoungas S, Tonkin AM. Assessment of Cardiovascular Disease Risk in South Asian Populations. *Int J Vasc Med* 2013; 20:1–10.
- [40] Mazidi M, Rezaie P, Karimi E, Salehi M, Nematy M. Effects of Ramadan Fasting on Lipid Profile : A Narrative Review. *J Fasting Heal* 2014; 2:57–61.
- [41] Bonakdaran S. Physiology of ramadan fasting. *J Fasting Heal* 2016; 4:64–9.

- [42] Lessan N, Hannoun Z, Hasan H, Barakat MT. Glucose excursions and glycaemic control during Ramadan fasting in diabetic patients: Insights from continuous glucose monitoring (CGM). *Diabetes Metab* 2015; 41:28–36. <https://doi.org/10.1016/j.diabet.2014.11.004>.
- [43] Alsaeed D, Al-Kandari J, Al-Ozairi E. Experiences of people with type 1 diabetes fasting Ramadan following structured education: A qualitative study. *Diabetes Res Clin Pract* 2019; 153:157–65. <https://doi.org/10.1016/j.diabres.2019.05.021>.
- [44] Zabeen B, Tayyeb S, Benarjee B, Baki A, Nahar J, Mohsin F, et al. Fasting during Ramadan in adolescents with diabetes. *Indian J Endocrinol Metab* 2014; 18:44–7. <https://doi.org/10.4103/2230-8210.126530>.
- [45] Al-Khawari M, Al-Ruwayeh A, Al-Doub K, Allgrove J. Adolescents on basal-bolus insulin can fast during Ramadan. *Pediatr Diabetes* 2010; 11:96–100. <https://doi.org/10.1111/j.1399-5448.2009.00544.x>.
- [46] Nasrallah MM, Osman NA. Fasting during the month of Ramadan among patients with chronic kidney disease: Renal and cardiovascular outcomes. *Clin Kidney J* 2014; 7:348–53. <https://doi.org/10.1093/ckj/sfu046>.
- [47] Hendawy A. Effect of Ramadan Fasting on Renal Physiology. *Urol Nephrol Open Access J* 2014; 1:74–7. <https://doi.org/10.15406/unoaj.2014.01.00017>.
- [48] Kidney Disease. Improving Global Outcomes (KDIGO) CKD-MBD Update Work Group. KDIGO 2017 Clinical Practice Guideline Update for the Diagnosis, Evaluation, Prevention, and Treatment of Chronic Kidney Disease–Mineral and Bone Disorder (CKD-MBD). *Kidney Int Suppliments* 2017; 7:1–59. <https://doi.org/10.1016/j.kisu.2017.04.001>.
- [49] Sandaesara TA, Dong B P, Dhindsa DS, Mehta A, Arneson LC, DOLLAR AL, et al. Intermittent Fasting: A Heart Healthy Dietary Pattern? *Am J Med* 2020; 30. <https://doi.org/10.1016/j.amjmed.2020.03.030>.
- [50] Moro T, Tinsley G, Bianco A, Marcolin G, Pacelli QF, Battaglia G, et al. Effects of eight weeks of time-restricted feeding (16/8) on basal metabolism, maximal strength, body composition, inflammation, and cardiovascular risk factors in resistance-trained males. *J Transl Med* 2016;14:1–10. <https://doi.org/10.1186/s12967-016-1044-0>.
- [51] Klempel MC, Kroeger CM, Bhutani S, Trepanowski JF, Varady KA. Intermittent fasting combined with calorie restriction is effective for weight loss and cardio-protection in obese women. *Nutr J* 2012; 11:1. <https://doi.org/10.1186/1475-2891-11-98>.
- [52] Eshghinia S, Mohammadzadeh F. The effects of modified alternate-day fasting diet on weight loss and CAD risk factors in overweight and obese women. *J Diabetes Metab Disord* 2013; 12:1. <https://doi.org/10.1186/2251-6581-12-4>.
- [53] Varady K, Bhutani S. Short-term modified alternate-day fasting: a novel dietary strategy for weight loss and cardioprotection in obese adults. *American Journal of Clinical Nutrition*, 90(5), 1138–1143. Doi: 10.39. *Am J Clin Nutr* 2009; 90:1138–43. <https://doi.org/10.3945/ajcn.2009.28380.1>.
- [54] Varady KA, Bhutani S, Klempel MC, Kroeger CM, Trepanowski JF, Haus JM, et al. Alternate day fasting for weight loss in normal weight and overweight subjects: A randomized controlled trial. *Nutr J* 2013; 12:1. <https://doi.org/10.1186/1475-2891-12-146>.
- [55] Harvie MN, Pegington M, Mattson MP, Frystyk J, Dillon B, Cuzick J, et al. The effects of intermittent or continuous energy restriction on weight loss and metabolic disease risk markers: a randomized trial in young overweight women. *Int J Obes* 2011; 35:714–27. <https://doi.org/10.1038/ijo.2010.171>.The.

- [56] Klempel MC, Kroeger CM, Varady KA. Alternate day fasting (ADF) with a high-fat diet produces similar weight loss and cardio-protection as ADF with a low-fat diet. *Metabolism* 2013; 62:137–43. <https://doi.org/10.1016/j.metabol.2012.07.002>.
- [57] Hoddy KK, Kroeger CM, Trepanowski JF, Barnosky A, Bhutani S, Varady KA. Meal timing during alternate day fasting: Impact on body weight and cardiovascular disease risk in obese adults. *Obesity* 2014; 22:2524–31. <https://doi.org/10.1002/oby.20909>.
- [58] Bhutani S, Klempel MC, Kroeger CM, Trepanowski JF, Varady KA. Alternate day fasting and endurance exercise combine to reduce body weight and favorably alter plasma lipids in obese humans. *Obesity* 2013; 21:1370–9. <https://doi.org/10.1002/oby.20353>.
- [59] Stekovic S, Hofer SJ, Tripolt N, Aon MA, Royer P, Pein L, et al. Alternate Day Fasting Improves Physiological and Molecular Markers of Aging in Healthy, Non-obese Humans Slaven. *Cell Metab* 2020; 30:878–81. <https://doi.org/10.1016/j.cmet.2020.02.011>.
- [60] Francis L, Young J, Lara J. The impact of intermittent fasting on body composition and cardiovascular biomarkers: a systematic review and meta-analysis. *Proc Nutr Soc* 2017; 76:2017. <https://doi.org/10.1017/s0029665117000982>.
- [61] Horne BD, Muhlestein JB, Lappé DL, May HT, Carlquist JF, Galenko O, et al. Randomized cross-over trial of short-term water-only fasting: Metabolic and cardiovascular consequences. *Nutr Metab Cardiovasc Dis* 2013; 23:1050–7. <https://doi.org/10.1016/j.numecd.2012.09.007>.
- [62] Sung MMY, Dyck JRB. Age-related cardiovascular disease and the beneficial effects of calorie restriction. *Heart Fail Rev* 2012; 17:707–19. <https://doi.org/10.1007/s10741-011-9293-8>.
- [63] Lefevre M, Ph D, Redman LM, Heilbronn LK, Julie V, Martin CK, et al. Caloric restriction alone and with exercise improves CVD risk in healthy and non-obese individuals. *Atherosclerosis* 2009; 203:206–13. <https://doi.org/10.1016/j.atherosclerosis.2008.05.036>. CALORIC.
- [64] Kobara M, Furumori-Yukiya A, Kitamura M, Matsumura M, Ohigashi M, Toba H, et al. Short-Term Caloric Restriction Suppresses Cardiac Oxidative Stress and Hypertrophy Caused by Chronic Pressure Overload. *J Card Fail* 2015; 21:656–66. <https://doi.org/10.1016/j.cardfail.2015.04.016>.
- [65] Kroeger CM, Klempel MC, Bhutani S, Trepanowski JF, Tangney CC, Varady KA. Improvement in coronary heart disease risk factors during an intermittent fasting/calorie restriction regimen: Relationship to adipokine modulations. *Nutr Metab* 2012; 9:1. <https://doi.org/10.1186/1743-7075-9-98>.
- [66] Beshyah S, Farooqi M, Farghaly M, Abusnana S, Al Kaabi J, Benbarka M, et al. Management of diabetes during ramadan fasting: A comprehensive survey of physicians' knowledge, attitudes, and practices. *Ibnosina J Med Biomed Sci* 2017; 9:28. <https://doi.org/10.4103/1947-489x.210107>.
- [67] Almalki MH, Hussen I, Khan SA, Almaghamsi A, Alshahrani F. Assessment of Ramadan education and knowledge among diabetic patients. *Clin Med Insights Endocrinol Diabetes* 2018; 11:1–7. <https://doi.org/10.1177/1179551417751611>.
- [68] Ibrahim M, Davies MJ, Ahmad E, Annabi FA, Eckel RH, and Ba-Essa EM, et al. Recommendations for management of diabetes during Ramadan: update 2020, applying the principles of the ADA/EASD consensus. *BMJ Open Diabetes Res Care* 2020; 8:1–14. <https://doi.org/10.1136/bmjdr-2020-001248>.
- [69] Ali S, Davies MJ, Brady EM, Gray LJ, Khunti K, Beshyah SA, et al. Guidelines for managing diabetes in Ramadan. *Diabet Med* 2016; 33:1315–29. <https://doi.org/10.1111/dme.13080>.
- [70] Afandi B, Nagelkerke WK, Fatima AK, Khalid AD. Ramadan challenges: Fasting against medical advice. *J Fasting Heal* 2018; 5:133–7. <https://doi.org/10.22038/JFH.2018.27312.1100>.

- [71] Lessan N, Hannoun Z, Hasan H, Barakat MT. Glucose excursions and glycaemic control during Ramadan fasting in diabetic patients: Insights from continuous glucose monitoring (CGM). *Diabetes Metab* 2015; 41:28–36. <https://doi.org/10.1016/j.diabet.2014.11.004>.
- [72] Alsaeed D, Al-Kandari J, Al-Ozairi E. Experiences of people with type 1 diabetes fasting Ramadan following structured education: A qualitative study. *Diabetes Res Clin Pract* 2019; 153:157–65. <https://doi.org/10.1016/j.diabres.2019.05.021>.
- [73] Bin-Abbas BS. Insulin pump therapy during Ramadan fasting in type 1 diabetic adolescents. *Ann Saudi Med* 2008; 28:305–8.
- [74] Benbarka MM, Khalil AB, Beshyah SA, Marjei S, Awad SA. Insulin pump therapy in moslem patients with type 1 diabetes during ramadan fasting: An observational report. *Diabetes Technol Ther* 2010; 12:287–90. <https://doi.org/10.1089/dia.2009.0130>.
- [75] Kaplan W, Afandi B. Blood glucose fluctuation during ramadan fasting in adolescents with type 1 diabetes: Findings of continuous glucose monitoring. *Diabetes Care* 2015; 38:e162–3. <https://doi.org/10.2337/dc15-1108>.
- [76] Bakiner O, Ertorer ME, Bozkirli E, Tutuncu NB, Demirag NG. Repaglinide plus single-dose insulin glargine: A safe regimen for low-risk type 2 diabetic patients who insist on fasting in Ramadan. *Acta Diabetol* 2009; 46:63–5. <https://doi.org/10.1007/s00592-008-0062-7>.
- [77] Salti I. Efficacy and safety of insulin glargine and glimepiride in subjects with Type 2 diabetes before, during and after the period of fasting in Ramadan. *Diabet Med* 2009; 26:1255–61. <https://doi.org/10.1111/j.1464-5491.2009.02836.x>.
- [78] Kalra S. Insulin degludec and insulin degludec/insulin aspart in Ramadan: A single center experience. *Indian J Endocrinol Metab* 2016; 20:564–7. <https://doi.org/10.4103/2230-8210.180644>.
- [79] Bashier AMK, Hussain AK Bin, Alawadi F, Alsayyah F, Alsaeed M, Rashid F, et al. Impact of optimum diabetes care on the safety of fasting in Ramadan in adult patients with type 2 diabetes mellitus on insulin therapy. *Diabetes Res Clin Pract* 2019; 150:301–7. <https://doi.org/10.1016/j.diabres.2019.01.037>.
- [80] Lou A, Hammoud M. Muslim patients' expectations and attitudes about Ramadan fasting during pregnancy. *Int J Gynecol Obstet* 2016; 132:321–4. <https://doi.org/10.1016/j.ijgo.2015.07.028>.
- [81] Ziaee V, Kihanidoost Z, Younesian M. The Effect of Ramadan Fasting on Outcome of Pregnancy. *Iran J Pediatr* 2012; 63:159–66. <https://doi.org/10.4025/jphyseduc.v30i1.3036>.
- [82] Ismail NAM, Raji HO, Wahab NA, Mustafa N, Kamaruddin NA, Jamil MA. Glycemic control among pregnant diabetic women on insulin who fasted during Ramadan. *Iran J Med Sci* 2011; 36:254–9.
- [83] Levin A, Tonelli M, Bonventre J, Coresh J, Donner JA, Fogo AB, et al. Global kidney health 2017 and beyond: a roadmap for closing gaps in care, research, and policy. *Lancet* 2017; 390:1888–917. [https://doi.org/10.1016/S0140-6736\(17\)30788-2](https://doi.org/10.1016/S0140-6736(17)30788-2).
- [84] Kassebaum NJ, Arora M, Barber RM, Brown J, Carter A, Casey DC, et al. Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016; 388:1603–58. [https://doi.org/10.1016/S0140-6736\(16\)31460-X](https://doi.org/10.1016/S0140-6736(16)31460-X).
- [85] Mbarki H, Tazi N, Najdi A, Tachfouti N, Arrayhani M, Sqalli T. Effects of fasting during Ramadan on renal function of patients with chronic kidney disease. *Saudi J Kidney Dis Transplant* 2015; 26:320–4. <https://doi.org/10.4103/1319-2442.152494>.

- [86] Bakhit AA, Kurdi AM, Wadera JJ, Alsuwaida AO. Effects of ramadan fasting on moderate to severe chronic kidney disease: A prospective observational study. *Saudi Med J* 2017; 38:48–52. <https://doi.org/10.15537/smj.2017.1.17566>.
- [87] Bakhit AA, Kurdi AM, Wadera JJ, Alsuwaida AO. Effects of Ramadan fasting on moderate to severe chronic kidney disease. *Saudi Med J* 2017; 38:48–52. <https://doi.org/10.15537/smj.2017.1.17566>.
- [88] Kara E, Sahin OZ, Kizilkaya B, Ozturk B, Pusuroglu G, Yildirim S, et al. Fasting in Ramadan is not associated with deterioration of chronic kidney disease: A prospective observational study. *Saudi J Kidney Dis Transplant* 2017; 28:68–75. <https://doi.org/10.4103/1319-2442.198140>.
- [89] Chowdhury A, Khan H, Lasker SS, Chowdhury TA. Fasting outcomes in people with diabetes and chronic kidney disease in East London during Ramadan 2018 : The East London diabetes in Ramadan survey. *Diabetes Res Clin Pract* 2019; 152:166–70. <https://doi.org/10.1016/j.diabres.2019.05.022>.
- [90] Wakeel J Al, Mitwalli AH, Alsuwaida A, Ghonaim M Al, Usama S, Hayat A, et al. Recommendations for fasting in ramadan for patients on peritoneal dialysis. *Perit Dial Int* 2013; 33:86–91. <https://doi.org/10.3747/pdi.2010.00095>.
- [91] Imtiaz S, Salman B, Dhrolia MF, Nasir K, Abbas HN, Ahmad A. Clinical and Biochemical Parameters of Hemodialysis Patients Before and During Islamic Month of Ramadan. *Iran J Kidney Dis* 2016; 10:75–8.
- [92] Wan Md Adnan WAH, Zaharan NL, Wong MH, Lim SK. The effects of intermittent fasting during the month of Ramadan in chronic haemodialysis patients in a tropical climate country. *PLoS One* 2014; 9:1–12. <https://doi.org/10.1371/journal.pone.0114262>.
- [93] Alshamsi S, Binsaleh F, Hejaili F, Karkar A, Moussa D, Raza H, et al. Changes in biochemical, hemodynamic, and dialysis adherence parameters in hemodialysis patients during Ramadan. *Hemodial Int* 2016; 20:270–6. <https://doi.org/10.1111/hdi.12369>.
- [94] Adanan NIH, Md Ali MS, Lim JH, Zakaria NF, and Lim CTS, Yahya R, et al. Investigating Physical and Nutritional Changes During Prolonged Intermittent Fasting in Hemodialysis Patients: A Prospective Cohort Study. *J Ren Nutr* 2020; 30:e15–26. <https://doi.org/10.1053/j.jrn.2019.06.003>.
- [95] Einollahi B, Lessan-Pezeshki M, Pourfarziani V, Aghdam B, Rouzbeh J, Ghadiani MH, et al. Ramadan fasting in kidney transplant recipients with normal renal function and with mild-to-moderate renal dysfunction. *Int Urol Nephrol* 2009; 41:417–22. <https://doi.org/10.1007/s11255-008-9476-y>.
- [96] Boobes Y, Bernieh B, Hakim MR Al. Fasting Ramadan in Kidney Transplant Patients is Safe. *Saudi J Kidney Dis Transplant* 2009; 20:198–200.
- [97] Qurashi S, Tamimi A, Jaradat M, Sayyari A Al. Effect of fasting for ramadan on kidney graft function during the hottest month of the year (August) in Riyadh, Saudi Arabia. *Exp Clin Transplant* 2012; 10:551–3. <https://doi.org/10.6002/ect.2012.0139>.
- [98] Ibrahim IA, Hassan EA, Alkhan AM, Hussein MA, Alhabashi AF, Ali TZ, et al. Ramadan Fasting in Kidney Transplant Recipients: A Single-Centre Retrospective Study. *J Transplant* 2018; 18:1–9. <https://doi.org/10.1155/2018/4890978>.
- [99] Hejaili F, Qurashi S, Binsalih S, Jaradt M, Al Sayyari A. Effect of repeated ramadan fasting in the hottest months of the year on renal graft function. *Nephrourol Mon* 2014; 6:2012–5. <https://doi.org/10.5812/numonthly.14362>.
- [100] Salem E, Akhili I, Akikli A. The Effect of Ramadan Fasting on the Kidney Function of Renal Transplant Recipients. *Arab J Nephrol Transplant* 2010; 3:29–32. <https://doi.org/10.4314/ajnt.v3i1.57597>.