Ramadan intermittent fasting for patients with gastrointestinal and hepatobiliary diseases: practical guidance for health-care professionals

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Ramadan intermittent fasting can pose challenges and risks for some groups of patients. Based on a narrative literature review and our clinical expertise, we provide practical guidance for clinicians managing patients with gastrointestinal and hepatobiliary conditions who wish to fast during Ramadan. Following the established International Diabetes Federation and Diabetes and Ramadan International Alliance risk stratification framework, we categorised patients' risk as low or moderate, high, or very high. We advise all patients at very high risk and most patients at high risk to not observe fasting due to potential harm. For others, we offer nuanced recommendations on medication rescheduling, lifestyle changes, and tailored fasting advice to minimise adverse effects. Shared decision making that respects patients' religious motivations is essential, with risks and benefits carefully weighed on an individual basis.

Introduction

Ramadan intermittent fasting (RIF) describes fasting between dawn and sunset during the Islamic month of Ramadan. It is one of the five pillars of Islam, observed by more than 90% of the approximately 2 billion Muslims worldwide.[1] During Ramadan, Muslim adults and children who have reached puberty ordinarily have a pre-dawn meal (Suhoor) and break their fast with a meal at sunset (Iftar), observing complete abstention from food, drink, smoking, and sexual activities in between. Complete abstinence even from liquids during the fasting hours makes RIF different from general intermittent fasting, in which the consumption of water and other beverages is allowed.[2] The health benefits of intermittent fasting potentially include protection against metabolic, cardiovascular, and neurodegenerative disorders, cancers, and even ageing.[3,4] RIF, being a type of intermittent fasting, might offer health benefits such as improvements in anthropometric measurements,[5] lipid profiles,[5] glucometabolic markers in patients with diabetes and healthy individuals,[6,7] blood pressure,[8] and liver function tests.[9]

The oral administration of medications nullifies fasting; however, Islamic scholars debate the permissibility of non-oral routes, such as nasal and rectal routes and inhalers, which might not invalidate the fast.[2,10] In northern regions, such as Europe, Canada, and the USA, fasting can exceed 18 h in the summer months.[2] Clinicians should be equipped with the knowledge to advise Muslim patients observing Ramadan on the effects and safety of fasting, and any potential adjustments to medication regimens.

Although fasting is an obligation, dispensations laid out by Islamic law (Shari'ah) offer exemptions for anyone whose wellbeing will be unduly adversely affected by fasting, including those with health conditions that could deteriorate during periods of abstinence from food, fluid, or medication; pre-pubescent children; and people who are frail, pregnant, or breastfeeding.[2,11,12] However, in the absence of medical advice, many Muslim patients fast despite clinically significant underlying disease,[2] and others might fast against medical advice,[13] which could carry considerable risk. Also, compliance with medication regimens and doses can be inconsistent during Ramadan.[14]

Informed shared decision making and risk-reduction strategies between patients and health-care professionals are crucial in improving the safety of fasting and preventing avoidable complications among people with particular health conditions.[15,16] There is, however, no current health-related consensus on the management of people with gastrointestinal or hepatobiliary disorders who opt to fast during Ramadan. We therefore conducted a narrative review of peer-reviewed literature focused on the effects and safety of RIF among people with gastrointestinal and hepatobiliary conditions, with the intention to present a broad perspective, identify key themes, and discuss the current state of knowledge. We grouped findings relevant to the study question by disease type.[17] The guidance presented in this Review is based both on studies found in the narrative literature review and our clinical experience. To broaden the evidence base underpinning this Review, we also discuss studies of non-Ramadan fasting and animal studies, although we did not base our recommendations on these animal studies. We also acknowledge that we extrapolated some findings from fasting types and models that do not exactly replicate the diurnal and dry fasting conditions of Ramadan.

To structure our recommendations, we used the well established International Diabetes Federation and Diabetes and Ramadan International Alliance (IDF–DAR) risk stratification model, using the categories of very high risk, high risk, and low or moderate risk.[18] This system has been followed to risk stratify patients with conditions such as diabetes,[19] hypoadrenalism,[20] cardiovascular conditions,[21]

and chronic kidney disease,[22] and recipients of solid organ transplants.[23] Although, in 2021, the IDF–DAR updated its guidance on risk stratification, moving away from a three-tier, traffic-light system based on the presence of certain characteristics to a scoring system that assigns a score to every risk element to determine the overall risk level,[18] this scoring system is not adequately validated and has several limitations for a diverse global usage.[24,25] Furthermore, there is no equivalent validated scoring system for gastrointestinal and hepatobiliary diseases; developing such a system was outside the scope of this Review. The three-tier, traffic-light system in figure 1 can be used by health-care professionals to risk-stratify patients with gastrointestinal and hepatobiliary conditions who are aiming to fast during the month of Ramadan.

Summary of evidence

Hepatobiliary diseases

Metabolic dysfunction-associated steatotic liver disease

Metabolic dysfunction-associated steatotic liver disease (MASLD; previously called non-alcoholic fatty liver disease [NAFLD]) is one of the leading causes of chronic liver disease worldwide.[27] Small observational studies in patients with MASLD have shown significant improvements in anthropometric measurements, liver aminotransferases, liver steatosis, and adipose-derived inflammatory molecules (eg, serpin A12 and intelectin-1) in people who are RIF compared with those not fasting.[28–32] Another study showed significant reductions in fasting glucose, plasma insulin, insulin resistance, and inflammatory cytokines in people with MASLD participating in RIF, compared with age-matched and sex-matched controls who were not participating in RIF (table 1).[33] In addition, a recent study on a rat MASLD model (fed a high-fat diet) noted significant hepatoprotective, anti-obesity, and anti-hyperlipidaemic effects of RIF modelling.[34]

Cai and colleagues[35] showed the positive effects of alternate-day fasting and time-restricted eating in 271 individuals with MASLD in a randomised controlled trial. Alternate-day fasting involved alternating between a so-called feed day with unrestricted food intake and a so-called fast day with 75% energy restriction, whereas time-restricted eating restricted food intake to an 8 h window daily. These regimens differ from RIF, which involves complete abstention from food and drink during daylight hours for a month, but share the principle of time-restricted eating. This trial showed a significant reduction in bodyweight in the alternate-day fasting (–4·56 kg [SD 0·41]) and time-restricted

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Very high risk Must not fast	High risk Should not fast	Low or moderate risk Seek medical advice, or could fast
• Patients with Child–Pugh class B or C cirrhosis • Patients with acute viral or non-viral hepatitis • Liver transplant recipients who had a transplantation within the past 12 months • Liver transplant recipients with poor graft function or allograft cirrhosis • Liver transplant recipients with rejection episodes in the the past 6 months • Liver transplant recipients with recent opportunistic infections • Liver transplant recipients on twice-daily immunosuppression living in regions where fasting lasts for more than 12 h • Liver transplant recipients with diabetes who require twice-daily (or more) insulin or oral hypoglycaemics • Patients with an acute flare of IBD, elevated faecal calprotectin (>250 µg/g*), or endoscopic or radiological findings of active IBD • Patients with acute pancreatitis • Patients with chronic pancreatitis • Patients with clinically significant† acute or chronic diarrhoea • Patients with high-output stoma (>1 L per 24 h) • Patients with objective evidence of frailty or pre-frail status based on accepted scales or tools • Patients with unhealed peptic ulcers • Patients on medication regimens requiring administration more than twice daily who cannot be safely titrated to once or twice-daily regimens using prolonged-release alternatives • Pregnant patients • Patients on parenteral nutrition	• Patients with Child–Pugh class A cirrhosis with evidence of malnutrition, frailty, or sarcopenia • Liver transplant recipients with reduced graft function, post-liver transplantation non-skin-related malignancy, or recurrence of hepatocellular carcinoma • Liver transplant recipients at high risk of dehydration or acute kidney injury, or immunosuppressant-induced nephrotoxicity, or those who would be unable to meet their daily fluid intake requirements • Patients with hepatocellular carcinoma who have undergone locoregional therapy or systemic therapy complicated by decompensation, dehydration, or malnutrition • Patients on prednisolone at doses >20 mg per day‡ • Patients with autoimmune hepatitis should avoid fasting if their disease is actively flaring	• Patients with Child–Pugh class A cirrhosis with no evidence of malnutrition, frailty, or sarcopenia • Liver transplant recipients with stable graft function and immunosuppression who are at least 1 year post-transplantation • Patients with stable chronic liver disease (eg, MASLD, autoimmune hepatitis, and chronic hepatitis B and C) without evidence of cirrhosis • Patients with Gilbert's syndrome • Patients with quiescent or mild IBD (asymptomatic with a acceptable faecal calprotectin*), including patients on immunosuppressants and advanced therapies • Patients with previous peptic ulcer disease (without evidence of unhealed ulcers) or GORD, with symptoms controlled by proton-pump inhibitors • Patients with irritable bowel syndrome • Patients with a stoma without high output • Patients with coeliac disease without ongoing diarrhoea • Patients with bile acid malabsorption without ongoing diarrhoea • Patients with microscopic colitis without ongoing diarrhoea

Figure 1: **Risk stratification for fasting in patients with gastrointestinal and hepatobiliary conditions based on the IDF–DAR risk categories**
Figure based on a Review by Hassanein and colleagues.[18] GORD=gastro-oesophageal reflux disease. IBD=inflammatory bowel disease. IDF–DAR=International Diabetes Federation and Diabetes and Ramadan International Alliance. MASLD=metabolic dysfunction-associated steatotic liver disease. *A normal concentration of faecal calprotectin varies between different laboratories and studies, and can be pragmatically considered to be <100–250 µg/g.[26] †Diarrhoea that could lead to dehydration. ‡Use of high doses of steroids might represent higher disease activity.

	Design	Number of patients or animals	Outcome measures	Results
MASLD				
Arabi et al (2015)[28]	Prospective observational study	50	Effects of RIF on biochemical tests, body composition, and anthropometric parameters in people with MASLD	Fasting led to improvements in HDL cholesterol, systolic blood pressure, diastolic blood pressure, and ALT (p<0·05)
Rahimi et al (2017)[29]	Prospective cross-sectional study	60	Effects of RIF on ALT	RIF increased ALT, but further study is needed
Ebrahimi et al (2018)[30]	Prospective observational study	83	Effects of RIF on anthropometric measures and circulating adipokines	Participants who fasted had improvements in mean hip circumference, BMI, and circulating concentrations of serum serpin A12 and intelectin-1 (p<0·05)
Ebrahimi et al (2020)[31]	Prospective observational study	83	Effects of RIF on liver function, Visceral Adiposity Index, and Atherogenic Index of Plasma	Individuals who fasted had significant improvements in total cholesterol and liver enzymes compared with those who did not fast; Atherogenic Index of Plasma and Visceral Adiposity Index decreased in both groups, but with no difference between groups
Aliasghari et al (2017)[33]	Prospective observational study	83	Effects of caloric restriction during RIF on anthropometric indices and biochemical tests in patients with MASLD	There were significant decreases in all anthropometric parameters and fasting glucose, plasma insulin, insulin resistance, and inflammatory cytokines between the beginning and the end of Ramadan in patients undergoing RIF
Alasmari et al (2023)[34]	Rat model of MASLD (high-fat diet)	48 rats	Potential benefits of RIF-like in mitigating MASLD	RIF improved alterations associated with MASLD, including lipid profile, hepatic steatosis, weight gain, and liver enzymes
Cai et al (2019)[35]	Randomised controlled trial	271	Effect of alternate-day fasting and time-restricted eating (versus control—no feeding restrictions) on bodyweight and body composition	Alternate-day fasting was efficacious at causing weight loss and improving dyslipidaemia within a relatively short period of time (4–12 weeks)
Mari et al (2021)[36]	Retrospective case–control study	155	Effects of RIF on anthropometric and disease severity scores	Fasting led to declines in BMI, BARD score, and Fibrosis-4 score
Gad et al (2022)[37]	Prospective observational study	40	Effects of RIF on CAP and LSM by transient elastography	RIF led to significant decreases in CAP and LSM
Liver cirrhosis				
Elnadry et al (2011)[38]	Observational and comparative study	202	Effects of RIF on clinical, laboratory, and ultrasonographic parameters in patients with chronic liver disease (202 with cirrhosis)	Adherence to therapy was better in the non-fasting versus fasting group; dyspeptic symptoms were worse during Ramadan in the fasting group; gastrointestinal bleeding during Ramadan was higher in the fasting group, but oesophageal variceal bleeding was significantly higher in the non-fasting group; the frequency of deterioration to Child–Pugh class C (from A and B) was high in the fasting group with cirrhosis both during and after Ramadan
Elfret et al (2011)[39]	Observational study	300	Effects of RIF on epidemiological, clinical, laboratory, and haemodynamic parameters in patients with liver cirrhosis	Fasting resulted in a decline in ALT, AST, γ-glutamyl transferase, and alkaline phosphatase; concentration of bilirubin increased; no change in creatinine; the authors concluded that patients with Child–Pugh class A liver cirrhosis with no history of gastrointestinal bleeding could benefit from RIF
Mohamed et al (2016)[40]	Observational study	40	Effects of RIF on portal blood flow and liver function in patients with cirrhosis who chose to fast	Study showed significant short-term increases in portal blood flow before versus after fasting, which could be accommodated in patients with Child–Pugh classes A and B; however, the authors concluded that patients with Child–Pugh class C should not fast
Mohamed et al (2018)[41]	Comparative study	72 (42 with cirrhosis)	Effects of RIF on portal haemodynamics and liver function in patients with cirrhosis and healthy individuals	Patients with liver cirrhosis showed an increase in portal vein congestion and MELD score and a decline in serum albumin, irrespective of their fasting state, compared with healthy individuals
Gastro-oesophageal reflux disease and laryngopharyngeal reflux disease				
Iraki et al (1997)[42]	Prospective observational study	9	Effects of RIF on the circadian rhythm of intragastric pH, gastrin, calcium, plasma insulin, and glucose in healthy male volunteers with healed duodenal ulcers	All studied biological variables, except plasma insulin, underwent changes in their 24-h mean concentration (eg, gastric pH decreased and plasma gastrin increased) and some of these changes persisted even 1 month after Ramadan
Mardhiyah et al (2016)[43]	Prospective observational cohort study	130	GERD-Q score at week 4 of Ramadan and 3 months after in fasting versus non-fasting patients	Significant decrease in GERD-Q score during Ramadan between fasting and non-fasting groups, and when comparing symptoms during the month of Ramadan versus a non-Ramadan month for the fasting group
Bohamad et al (2023)[44]	Longitudinal study	53	Effects of RIF on gastro-oesophageal health-related quality of life self-administered survey	Improvements in symptoms, with a reduction in the 45-point heartburn score from 17·9 during Ramadan to 14·3 thereafter and a reduction in regurgitation score from 12·3 to 9·9
Chandra et al (2013)[45]	Randomised, double-blinded study	30	Effects on DSSI score of omeprazole versus placebo in patients doing RIF	In patients fasting during Ramadan, there was a significantly smaller increase in DSSI scores for those taking omeprazol (2·7 [SD 0·7]) than those taking placebo (8·3 [7·2], p=0–02), indicating better control of dyspepsia symptoms with omeprazol in RIF

(Table 1 continues on next page)

	Design	Number of patients or animals	Outcome measures	Results
(Continued from previous page)				
Hamdan et al (2012)[46]	Observational single-arm cohort	22	Effect of general fasting for at least 12 h on laryngeal examination and Reflux Symptom Index in male patients with laryngopharyngeal reflux disease	When fasting, there was a non-significant increase in laryngopharangeal reflux disease prevalence (50% *vs* 32%, p=0·361), and increases in throat clearing (68% *vs* 64%), postnasal drip (59% *vs* 45%), and globus sensation (50% *vs* 36%) symptoms, whereas laryngeal findings remained similar between fasting and non-fasting conditions
Peptic ulcer disease and related complications				
Kocakusak et al (2017)[47]	Retrospective review of patients who were operated on in a Turkish hospital due to peptic ulcer perforation	2311	Peptic ulcer perforation rates (surgical intervention rates) during RIF periods versus non-RIF periods	The rate of surgical intervention for peptic ulcer perforation was significantly higher during RIF versus non-RIF months
Bener et al (2006)[48]	Retrospective study of consecutive patients presenting over a 10-year period to a single emergency department in the United Arab Emirates	470	Rate of peptic ulcer disease during and after Ramadan	No significant difference was found in the rates of peptic ulcer disease
Dönderici et al (1994)[49]	Retrospective study of patients with peptic ulcer disease in a Turkish hospital	1114	Effects of RIF on peptic ulcer disease complication rates	The rates of peptic ulcer complications (bleeding or perforation) were higher during Ramadan versus before and after Ramadan
Gokakin et al (2012)[50]	Prospective cohort study	321	Effects of RIF on peptic ulcer disease in patients referred for upper gastrointestinal endoscopy (mainly for epigastric pain)	The prevalence of duodenitis and duodenal ulcers was highest in the Ramadan month versus before or after
Inflammatory bowel disease				
Tavakkoli et al (2008)[51]	Prospective cohort study	60	Effects of RIF on Ulcerative Colitis Clinical Activity Index, Crohn's Disease Activity Index, Short Form Health Survey-36, Hospital Anxiety and Depression Scale, and Inflammatory Bowel Disease Questionnaire-9 in patients in remission	No changes in disease activity (except for decreases in Ulcerative Colitis Clinical Activity Index in men) and quality of life during Ramadan
Negm et al (2022)[52]	Prospective cohort study	80	Effects of RIF on C-reactive protein, calprotectin, Mayo score, Harvey–Bradshaw Index, Short Inflammatory Bowel Disease Questionnaire, and Hamilton Depression Rating Scale	Worsening of Mayo scores for ulcerative colitis before versus after Ramadan; no changes in all other assessments

ALT=alanine aminotransferase. AST=aspartate aminotransferase. BARD=BMI, AST to ALT ratio, and diabetes. CAP=controlled attenuation parameter. DSSI=Dyspepsia Symptom Severity Index. GERD-Q=Gastroesophageal Reflux Disease Questionnaire. LSM=liver stiffness measurement. MASLD=metabolic dysfunction-associated steatotic liver disease. RIF=Ramadan intermittent fasting.

Table 1: **Studies investigating the effects of RIF or fasting on gastrointestinal and hepatobiliary conditions**

eating (–3·62 kg [0·65]) groups compared with the control that was allowed to feed with no restrictions (–2·24 kg [0·34]; p<0·001) as early as 4 weeks. Fat mass was also significantly reduced at 4 weeks in the alternate-day fasting group (–3·49 kg [0·37]) and time-restricted eating group (–2·91 kg [0·41]) compared with the control group (p<0·001). Further significant reduction in fat mass at 12 weeks was seen in the alternate-day fasting group (–3·48 kg [0·38]) compared with the time-restricted eating group (–2·62 kg [0·34]) and the control group (–1·05 kg [0·45]; p<0·001). Serum triglycerides were also improved by the interventions at both 4 and 12 weeks, whereas total cholesterol significantly reduced only in the alternate-day fasting group.

In a retrospective case–control study, Mari and colleagues[36] showed the positive effects of RIF on various non-invasive fibrosis scores. This study included 155 participants with metabolic dysfunction-associated steatohepatitis, of whom 74 fasted and 81 did not. After Ramadan, the fasting group had significant reductions in BMI (36·7 kg/m² [SD 7·1] to 34·5 kg/m² [6·8]; p<0·003), NAFLD Fibrosis Score (0·45 [SD 0·25] to 0·23 [0·21]; p<0·005), aspartate aminotransferase (AST) to alanine aminotransferase (ALT) ratio, and diabetes (known as

BARD) score (2·30 [SD 0·98] to 1·60 [1·01]; p<0·005); and Fibrosis-4 score (1·93 [SD 0·76] to 1·34 [0·87]; p<0·005), whereas in the non-fasting group, BMI remained the same, with marginal declines in the other parameters. Similarly, Gad and colleagues[37] used transient elastography in 40 participants with MASLD observing RIF to show significant improvements after the month of Ramadan in controlled attenuation parameter scores and liver stiffness measurements.

Liver cirrhosis

Patients with cirrhosis are at risk of malnutrition, with associated risks of morbidity and mortality. Contributing factors to malnutrition in patients with cirrhosis include inadequate intake of macronutrients and micronutrients, inadequate uptake of macronutrients and micronutrients (including maldigestion, malabsorption, and metabolic dysregulation), inflammation, and gut microbiome dysbiosis.[53] Notably, patients with cirrhosis have altered macronutrient metabolism, producing a catabolic response to fasting, with early, excessive activation of lipolysis, the use of fat stores, and a switch from glycogenolysis to gluconeogenesis, proteolysis, and muscle breakdown.[54] Patients with cirrhosis, after overnight fasting, mirror the metabolic responses of healthy individuals after 3 days of starvation.[55]

Research on the effects of RIF in patients with cirrhosis is limited to a few small, observational studies (table 1).[38–40] A comparative observational study by Elnadry and colleagues[38] included 202 patients with chronic liver disease (103 participating in RIF and 99 not participating), excluding those with Child–Pugh class C cirrhosis. The study period lasted from 2 weeks before until 3 weeks after Ramadan, and the participants underwent clinical, biochemical, endoscopic, and ultrasonographic assessments before, during, and after Ramadan. The study found a propensity towards new decompensation from Child–Pugh class A and B to Child–Pugh class C in patients with cirrhosis who were fasting, with 13% newly developing Child–Pugh class C cirrhosis during the month of Ramadan, rising to a total of 33% having developed Child–Pugh class C cirrhosis by the last follow-up after Ramadan.[38]

In an Egyptian multicentre study, Elfret and colleagues[39] followed up 216 patients with Child–Pugh class A, B, or C cirrhosis who were participating in RIF, and found older age, diabetes, and Child–Pugh class C cirrhosis to be independent risk factors for deterioration in serum bilirubin and creatinine concentrations during RIF. Child–Pugh class A cirrhosis was, however, found to be an independent predictor of improvements in liver enzymes and serum glucose during fasting.[39]

Mohamed and colleagues[40] found a significant increase in portal vein congestion indices in patients with Child–Pugh class A or B cirrhosis from before to after the month of Ramadan (congestion index in patients with Child–Pugh class A 0·20 [SD 0·10] *vs* 0·25 [0·10], p<0·001; congestion index in patients with Child–Pugh class B 0·25 [0·10] *vs* 0·29 [0·10], p<0·001), but not in patients with Child–Pugh class C cirrhosis.[40] This congestion index has been shown to be a highly sensitive and specific correlate of portal hypertension.[56] A significant shift towards more advanced Child–Pugh classes was noted after fasting, and there was an increased risk of chemical decompensation (worsening bilirubin and albumin) among patients with Child–Pugh class C cirrhosis. When comparing before versus after Ramadan, although there was an increase in major adverse liver outcomes (hepatic encephalopathy and upper gastrointestinal bleeding) in patients with Child–Pugh class C cirrhosis, this increase was not statistically significant.[40] In a more recent study, Mohamed and colleagues[41] compared the effects of RIF on portal vein haemodynamics and liver function among patients with cirrhosis, who either did or did not fast, and healthy individuals who fasted. There was no significant difference in the portal vein congestion index score before versus after Ramadan between the fasting and non-fasting groups with cirrhosis (p=0·54) but the congestion index score was higher in patients with cirrhosis than in healthy individuals (p=0·000). Similarly, changes in MELD score and albumin concentration before versus after Ramadan were not significantly different between the fasting and non-fasting groups with cirrhosis, but were significantly different (MELD score increased more and albumin decreased more) compared with healthy individuals.[41]

Liver transplant recipients

Two studies investigating the effects of RIF on liver transplant recipients were identified through our literature search. Derbala and colleagues[57] conducted a retrospective study of 96 liver transplant recipients with normal graft function, classified into fasting and non-fasting groups, in Qatar, between 2008 and 2017. During these years, the duration of RIF ranged from 12 h to 15 h daily. Bivariate analysis showed no significant differences in haematological (platelet count and haemoglobin) and biochemical parameters (albumin, total bilirubin, alkaline phosphatase, AST, ALT, triglycerides, and creatinine) between the fasting and non-fasting groups. Tacrolimus trough concentrations also did not differ between the two groups (p=0·97). The authors concluded that liver transplant recipients with stable graft function, without cirrhosis of the allograft, could safely fast.

Montasser and colleagues[58] prospectively investigated 45 liver transplant recipients in Egypt who wished to participate in RIF, had reported no rejection episodes within the previous 6 months, had stable liver and renal functions for at least 3 months before Ramadan, and were at least 1-year post-transplantation. They found a significant rise in serum creatinine (p=0·004) and a significant decrease in the estimated glomerular filtration rate (p<0·01) post-Ramadan. Most

participants (37 [82%] of 45) fasted for the whole month of Ramadan, and five (11%) stopped fasting due to an unacceptable change in renal function. There were no changes in liver function, tacrolimus trough concentrations, or potassium concentrations before versus after Ramadan. The authors concluded that adjustment of immunosuppression protocols, adequate fluid intake during non-fasting hours, and regular follow-up of clinical and biochemical status are needed for liver transplant recipients who wish to fast during Ramadan.

Acute hepatitis

We identified no studies investigating the effect of RIF in acute hepatitis (viral or non-viral) in humans through our literature search. A previous review by Emara and colleagues[59] also did not identify any relevant articles. Previous guidance has recommended against fasting in patients with acute hepatitis given the risk of malnutrition and dehydration and the fact that they often require supportive measures such as eating frequent, small meals.[59,60] A rat model of non-viral acute hepatitis showed that fasting for 48 h can precipitate liver injury and lead to the intensification of dystrophic and necrotic damage to the liver architecture; however, in addition to the evident differences between human and rat models of acute hepatitis, the metabolic and immunological effects of the fasting regimen used might be different from those from RIF.[61]

Chronic hepatitis B

Research in transgenic mice models of chronic hepatitis B found that fasting for 48 h caused transient increases in hepatitis B virus RNA and DNA synthesis to a modest extent, possibly by activating the hepatocyte nuclear factor 4α.[62] The authors debate whether these transient increases in viral load due to a short period of fasting are relevant, but suggest that these effects could become more relevant over time with long-term caloric restriction or fasting. Still, further studies on the effects of caloric restriction on disease progression in chronic viral hepatitis are needed as the clinical relevance is unclear, especially given the trouble with extrapolating animal data on a non-RIF regimen to humans participating in Ramadan. No relevant studies on hepatitis C were identified.

Hepatocellular carcinoma

We identified no human studies through our search that assessed the effects of general fasting on reducing the risk of hepatocellular carcinoma in high-risk groups or improving response to current first-line therapies. Although there is evidence from in-vitro studies and murine models on the beneficial effects of fasting in the treatment or prevention of hepatocellular carcinoma, RIF specifically has not been studied in vitro or in animals.[63–65] Despite no direct human evidence, the mechanism through which fasting is postulated to be beneficial for hepatocellular carcinoma is by inducing apoptosis by downregulating the N-lysine methyltransferase KMT5A (known as SET8) enzyme, which is involved in cancer cell migration, proliferation, and invasiveness. Fasting might potentially also downregulate nuclear factor erythroid 2-related factor 2 and upregulate Kelch-like ECH-associated protein 1, leading to hepatocellular carcinoma cell apoptosis.[64]

No studies were identified that assessed the effects of general fasting on the action of the established first-line immunotherapeutic regimens for unresectable hepatocellular carcinoma (atezolizumab–bevacizumab and tremelimumab–durvalumab). In one preclinical study of the hepatocellular carcinoma therapy sorafenib, fasting was found to improve sorafenib efficacy and sensitise hepatocellular carcinoma cancer cells to sorafenib through p53-dependent metabolic synergism.[66] Sorafenib-resistant hepatocellular carcinoma cells rely on anaerobic glycolysis as an alternative energy-generating mechanism. Fasting reduces glucose supply and thereby impedes the PI3K/AKT/mTOR signalling pathway that is involved in hepatocellular carcinoma pathogenesis. Furthermore, reduced glucose supply also facilitates a Warburg shift, thus increasing reactive oxygen species production, which in turn facilitates the apoptosis of cancer cells.

Pancreatitis and gallstones

In a retrospective observational study that evaluated 1167 patients over a 10-year period, Drozdinsky and colleagues[67] showed an increased risk of being admitted to an emergency department for acute pancreatitis during Ramadan for those who fasted compared with those who did not fast. Using rat models to assess the effects of fasting on gallstone-related acute pancreatitis by the occlusion of the common bile duct, Yoshinaga and colleagues[68] showed that fasting exacerbated gallstone-related acute pancreatitis, with 50% of the rats dying by 6 days after ligation in the fasting group versus none in the non-fasting group. Results from an animal study involving 15 prairie dogs (eight fasted for 16 h, seven non-fasted controls) found that 16-h fasting increased the concentrations of bilirubin and calcium in gallbladder bile, which was postulated to partially account for the formation of pigment gallstones seen clinically with prolonged fasting.[69]

Other hepatobiliary conditions

To our knowledge, there are currently no human studies evaluating the role of fasting in Wilson's disease. One study of acrylamide exposure, a known neurotoxin, and intermittent fasting in rats found that acrylamide increased blood copper concentrations—copper being the key build-up in Wilson's disease—but that intermittent fasting caused a reduction (although not statistically significant) in copper in the presence of acrylamide.[70]

Gilbert's syndrome is a disorder of bilirubin glucuronidation leading to unconjugated hyperbilirubinaemia in the absence of haemolysis and hepatocellular injury,

which might be exacerbated during periods of fasting.[71] Kamal and colleagues[72] noted in their cross-sectional study that, out of 83 participants with Gilbert's syndrome, 60 (72%) had overt hyperbilirubinaemia with prolonged fasting (>12 h) during the month of Ramadan. Furthermore, the study suggested that the concentrations of bilirubin in Gilbert's syndrome directly correlated with the duration of fasting, with concentrations being lower or normal during periods of shorter fasting or no fasting.[72]

No in-vitro, animal, or human studies were identified through our search on the effects of general fasting on other hepatobiliary conditions, such as haemochromatosis, autoimmune hepatitis, primary biliary cholangitis, primary sclerosing cholangitis, chronic pancreatitis, or α-1 anti-trypsin deficiency.

Luminal gastrointestinal diseases

Gastro-oesophageal reflux disease

The existing literature on the effect of RIF on gastro-oesophageal reflux disease shows varied results. A small study comparing six patients with healed duodenal ulcers with nine healthy controls found that, during Ramadan fasting, the patients with healed ulcers showed approximately 8 h of continuously low gastric pH (high acidity) during daytime fasting hours, along with unexpectedly high plasma gastrin, compared with their post-Ramadan values and with healthy controls during Ramadan. This pattern suggests a potential risk for ulcer relapse during RIF.[42] Other studies provide conflicting results, with some suggesting improvements in gastro-oesophageal reflux disease symptoms during RIF,[43–45] and others reporting worsening symptoms (table 1).[46] It is crucial to acknowledge that gastro-oesophageal reflux disease is a multifactorial condition influenced by various lifestyle factors, many of which undergo notable alterations during Ramadan.[73] The complex interplay between RIF and gastro-oesophageal reflux disease is therefore probably mediated by several factors. Ramadan can be associated with substantial modifications in sleep patterns, including reduced nocturnal and total sleep time, a delay in bedtime, and rise time brought forward. These circadian rhythm disruptions could affect gastric motility and the function of the lower oesophageal sphincter, potentially influencing gastro-oesophageal reflux disease symptoms.[74] Additionally, the proximity of evening meals to sleep onset, as is often the case during Ramadan in the summer months, has been shown to exacerbate gastro-oesophageal reflux disease symptoms.[75,76] None of the studies on reflux found through our search accounted for the effects of confounding lifestyle factors, such as changes in sleep cycle, volume of meals, and types of food consumed, which might affect symptoms of gastro-oesophageal reflux disease during RIF.

A small, single-centre, randomised, double-blinded study evaluated the effects of omeprazole versus placebo in patients with dyspepsia symptoms participating in RIF.[45] Omeprazole ameliorated increases in Dyspepsia Symptoms Severity Index (DSSI) with RIF (DSSI increased from 27·2 [SD 9·4] to 30·0 [8·9] in the omeprazole group *vs* from 27·7 [14·0] to 36·0 [14·8] in the placebo group), suggesting improvements in symptoms with the use of a proton-pump inhibitor.[45]

Peptic ulcer disease

Different observational studies have shown conflicting results regarding the occurrence of peptic ulcer disease during Ramadan compared with other months of the year in predominantly Muslim countries.[47,48] However, these studies have not taken into account confounding factors (eg, changes in sleep patterns and types and volumes of meals) during RIF that might affect the symptoms of peptic ulcer disease.

One study reported a significantly higher rate of peptic ulcer disease-related perforation requiring surgical intervention during Ramadan compared with other months (14·05 procedures per month *vs* 4·55, p<0·001).[47] This single-centre, retrospective study done over 36 years (to complete the progression of 36 years of the lunar cycle of Ramadan to avoid seasonal contribution) provided valuable long-term data. However, the retrospective nature of this study and shortage of control for confounding factors might restrict the strength of its conclusions. Dönderici and colleagues[49] retrospectively analysed the complications of peptic ulcer disease in a single centre between 1987 and 1992, which were higher during Ramadan than in the periods before or after Ramadan. Upper gastrointestinal bleeding was the most common complication during Ramadan, occurring in 855 (76·8%) of 1114 cases, followed by ulcer perforation in 244 (21·9%) of 1114 cases.[49]

In a prospective, single-region study from Turkey, Gokakin and colleagues[50] divided participants undergoing upper gastrointestinal endoscopy as part of a diagnostic investigation (mainly for epigastric pain) into three groups over 3 years: participants examined 1 month before, during, and 1 month after Ramadan. The prevalence of duodenitis and duodenal ulcers was highest in the group examined during Ramadan (p=0·04), but there was no difference in endoscopic findings of the oesophagus or stomach.[50]

In contrast with these findings, Bener and colleagues[48] found no significant difference in the rates of peptic ulcer disease during and after Ramadan in a retrospective study conducted in the United Arab Emirates over 10 years. This discrepancy highlights the potential influence of other confounders, such as comorbidities, diet, medications, and health-care-seeking behaviours, which were all largely unaccounted for.[48]

Inflammatory bowel disease

The effect of RIF on patients with inflammatory bowel disease (IBD) remains uncertain, with murine models of IBD showing potential benefits of fasting, but human

studies yielding conflicting results. In murine models of IBD, fasting-mimicking diets have been associated with increased intestinal regeneration, reduced inflammation, and favourable changes in gut microbiota diversity;[77] the purported mechanisms include attenuated lymphocytic infiltration and reduced intestinal $CD4^+$ cell accumulation.[78]

However, a small, prospective study of 60 patients with IBD in remission found no significant changes in disease activity, symptoms, or quality of life with RIF, except reduced colitis activity index scores in men (p=0·008).[51] Conversely, another study of 80 patients showed worsening of partial Mayo scores after Ramadan (mean 1·79 before Ramadan *vs* 2·33 after, p=0·02) in patients with ulcerative colitis but no significant changes in Harvey–Bradshaw Index (median 4 *vs* 5, p=0·4) in patients with Crohn's disease.[52] Older age and higher baseline calprotectin concentrations were associated with deterioration in Mayo scores.[52] Both studies are limited by their small sample sizes and short follow-up periods.

Several randomised controlled trials are underway to explore the link between fasting and IBD, including the effects of an intermittent reduced-calorie diet on Crohn's disease (NCT04147585), time-restricted eating in Crohn's disease (NCT04271748), and a fasting-mimicking diet in ulcerative colitis (NCT03615690), although these trials are not specifically examining RIF.

People with a stoma

Studies have shown significant alterations in RIF rates following stoma formation in Muslim patients. Ikbal and colleagues[79] reported that the proportion of 66 Muslim patients who observed fasting significantly decreased from 58 (88%) to 29 (44%) before versus after stoma creation (p<0·01), with the most frequently cited reasons for abstaining from fasting being fear of damaging the stoma (20 [69%] of 29) and discomfort (eight [28%]).[79] In a questionnaire-based quality-of-life study that involved 178 Muslim patients who had undergone curative surgery for colorectal cancer, Kuzu and colleagues[80] found that patients who had a stoma as a result of sphincter-sacrificing surgery were more likely to refrain from RIF than those who had a stoma from sphincter-sparing surgery. Despite patients' perceptions that fasting might damage their stoma or cause ill-health, a prospective study by Altuntas and colleagues[81] suggests that RIF is safe in people with stomas. In 56 Muslim patients with cancer-related stomas, there were no differences in quality of life, nutrition, or health status between those who fasted (n=14) and those who did not (n=42), although the findings are limited by the small number of participants who observed RIF.[81]

Other luminal conditions

We did not identify any relevant studies synthesising the effects of RIF or similar types of fasting on patients with irritable bowel syndrome, coeliac disease, microscopic colitis, or bile acid malabsorption, or for those receiving parenteral nutrition.

Summary of evidence

The current evidence on RIF in patients with gastrointestinal and hepatobiliary conditions is mostly limited to small, underpowered, observational studies without adequate controls or prolonged follow-up beyond the month of Ramadan. This evidence does suggest that fasting could be safe in many patients with chronic gastrointestinal and hepatobiliary conditions that are in remission (or are being succesfully treated) or those with functional gastrointestinal diagnoses (eg, irritable bowel syndrome). However, certain patients, particularly those susceptible to organ dysfunction, should not fast. On the basis of the available evidence and our clinical experience, we make broad recommendations regarding the safety of RIF for patients with gastrointestinal and hepatobiliary conditions.

Recommendations

General recommendations

We suggest that all patients with gastrointestinal and hepatobiliary conditions wanting to fast during Ramadan should be individually assessed by an appropriate health-care professional before Ramadan. Assessments should include the patient's nutritional status, risk of malnutrition, and levels of frailty and sarcopenia. An individualised approach should be used when advising patients with these conditions as to whether fasting during Ramadan is feasible, due to the high heterogeneity and variability in patients' response to fasting—metabolic, inflammatory, and anthropometric responses to RIF vary according to genetic makeup and environment.[82] Health-care professionals should provide advice on the safety of fasting and suggest any diet or medication adjustments. To guide decision making, we provide a risk stratification (figure 1) and a flow chart (figure 2).

MASLD

Patients with MASLD without advanced fibrosis or cirrhosis are at low risk of adverse effects during fasting. We suggest that individuals with MASLD consult their physicians before fasting to ensure that they do not have relevant concomitant conditions, such as poorly controlled diabetes (especially with frequent episodes of hypoglycaemia), which might preclude them from fasting.

Liver cirrhosis

There are strong data to suggest that malnutrition and associated frailty and sarcopenia can predict complications in people with liver cirrhosis.[53] Malnutrition is an important negative prognostic feature of liver cirrhosis, which can be exacerbated by periods of time-restricted eating or fasting. Plank and colleagues[55] showed that avoidance of night-time fasting by providing a late

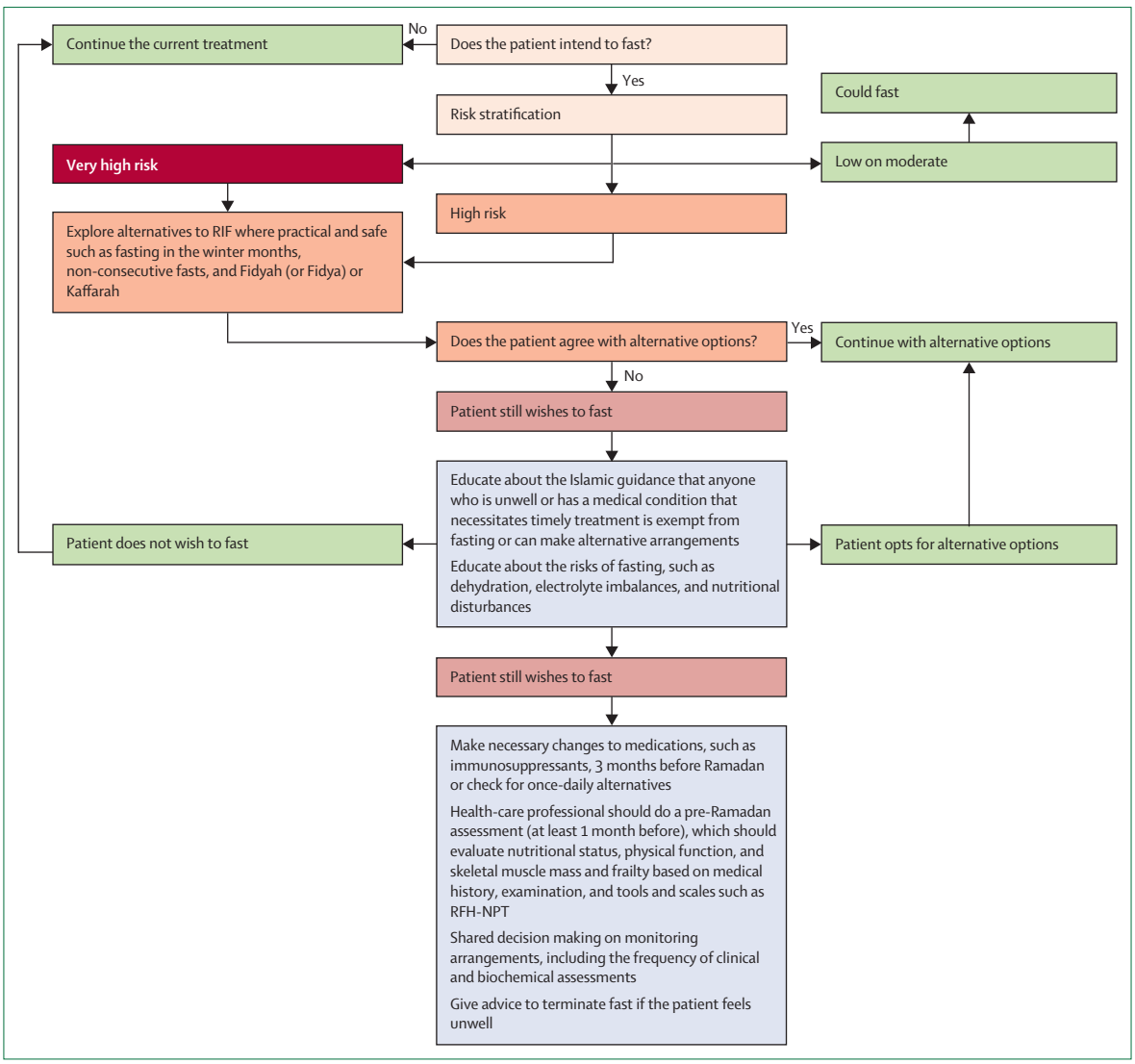

Figure 2: **Decision-making flowchart for observation of Ramadan fasting**
Fidya or Kaffara are donations that are made when broken or missed fasts cannot be made up.[2] RFH-NPT=Royal Free Hospital Nutritional Prioritizing Tool.

evening snack, in the form of a calorie-rich protein supplement before bedtime, to patients with liver cirrhosis, provided a positive effect on total body protein equivalent to about 2 kg of lean muscle. The authors speculated that a diet high in energy and protein, consumed frequently and late in the evening to ameliorate the effect of night-time fasting, might be associated with reduced hospitalisation rates and reduced mortality by improving the nutrition status of these patients, but further research is needed.[55] It is reasonable to suggest—and corroborated by guidance from North American and European hepatology societies—that fasting for more than 3–4 h should be avoided in patients with cirrhosis, especially those with Child–Pugh class B and C cirrhosis, due to the risk of worsening protein-energy malnutrition, aggravating catabolism, and increasing decompensation.[53,83] Some literature suggests that patients with Child–Pugh class A compensated cirrhosis could safely fast; however, in light of the risks of malnutrition, these decisions need to be carefully individualised after a thorough assessment of nutritional status, skeletal muscle mass, and frailty, and extensive and open discussions on benefits versus risks, while respecting the patient's autonomy. If a decision is made to pursue fasting in Ramadan by patients with Child–Pugh class A cirrhosis, protein supplementation during Suhoor and Iftar should be encouraged such that protein intake goals of 1·2–1·5 g/kg of bodyweight are met each day.[53]

Liver transplant recipients

Malik and colleagues[23] have provided detailed guidance on the suitability of RIF in solid organ transplant

recipients. The clinical risks of fasting in liver transplant recipients include graft dysfunction due to variable levels of immunosuppressive drugs, changes in fluid status and blood pressure, and hospitalisation (eg, due to signs of infection or graft dyfunction or failure). Malik and colleagues recommended that solid organ transplant recipients be educated on Islamic guidance on exemptions from fasting, which include old age, frailty, and stable conditions (eg, liver transplant) that can be exacerbated by fasting.[22] Ultimately, the decision to fast is a deeply personal one. If liver transplant recipients opt to fast, the authors recommend a thorough clinical assessment should be made at least 3 months before Ramadan, and should include plans to adjust the immunosuppressive regimen (eg, from twice daily to once daily, if appropriate) and regularly monitor graft function and other biochemical and haematological parameters. Patients should be risk-stratified on the basis of figure 1.

Acute and chronic hepatitis

The management of acute viral or non-viral hepatitis is usually supportive, with adequate oral intake, analgesia, and rest.[59] Patients with ongoing vomiting, dehydration, and those at risk of acute liver failure should be managed as inpatients, and would thus be excused from fasting on account of a severe acute illness.

Healthy individuals with chronic hepatitis B or C, without evidence of cirrhosis, and with stable viral load, could be able to fast; despite the lack of strong data, nutritional and infectivity risks of fasting are probably low, and thus the desire of the patient to fast should be respected. Treatment-naive patients with chronic hepatitis C can wait until after Ramadan to initiate the therapy—these patients have often been infected for a long time before diagnosis, so a delay by 1 month is not unthinkable; also, during Ramadan, intravenous recreational drug use, blood transfusions, intravenous fluid administration, and sexual activity void the fast, so the risk of transmission might be lower during Ramadan. Patients with cirrhosis should be managed as recommended in the section on cirrhosis.

Pancreatitis and gallstones

Health-care professionals should counsel patients that fasting could exacerbate symptoms in individuals with frequent biliary colic, although this assumption is based on animal data (no direct human data exist). Patients with acute pancreatitis and those with established chronic pancreatitis must not fast due to the risk of malnutrition and potential relapse of symptoms.[67]

Other hepatobiliary conditions

RIF can exacerbate unconjugated hyperbilirubinaemia associated with Gilbert's syndrome. However, these patients could fast (as hyperbilirubinaemia is self-limiting without clinical consequences in Gilbert's syndrome), and should be reassured that concentrations of bilirubin generally return to baseline after resumption of a regular diet.[72]

There is an absence of evidence and expert consensus regarding RIF in patients with other hepatobiliary conditions, including haemochromatosis, Wilson's disease, hepatocellular carcinoma, primary biliary cholangitis, primary sclerosing cholangitis, and α-1 anti-trypsin deficiency. However, our general recommendations should be applicable. Individuals without evidence of cirrhosis could be able to fast safely. Venesection, recommended in patients with haemochromatosis and high ferritin concentrations, is associated with large blood volume losses that would invalidate the fast.[84] Individuals with stable disease who do not require frequent venesections can explore moving their venesection sessions around Ramadan. We recommend, despite the sparse evidence, that individuals with autoimmune hepatitis avoid fasting if their disease is actively flaring, when on high-dose steroids (defined as prednisolone >20 mg/day), or if they have concomitant evidence of Child–Pugh class B or C cirrhosis.

Gastro-oesophageal reflux disease and peptic ulcer disease

Patients with gastro-oesophageal reflux disease could fast during Ramadan without clinically significant health risk, with adequate lifestyle and medication adjustments. They could benefit from dietary advice before Ramadan, with a focus on avoiding dietary triggers and large meals before sleeping. Patients on proton-pump inhibitors can safely continue treatment once or twice daily, taken half an hour before Suhoor, Iftar, or both (if twice daily). The safety of RIF for patients with a history of peptic ulcer disease has not been well established in the literature. However, given that proton-pump inhibitor therapy typically achieves effective healing of peptic ulcer disease within 4 weeks, we suggest that patients with fully healed peptic ulcer disease could be able to safely undertake RIF. This recommendation is based on clinical reasoning rather than direct evidence, highlighting the need for further high-quality research in this area. However, the increased rate of peptic ulcer disease-related perforation and gastrointestinal bleeding during Ramadan would suggest that patients with known active peptic ulcer disease must not fast during Ramadan.[85,86]

IBD

Our recommendations for fasting for patients with IBD differ depending on the severity of the disease, as assessed by markers of disease activity such as faecal calprotectin or endoscopic activity indices. Patients with quiescent or mild disease activity could fast with no or minimal medication adjustment, and, on the basis of available evidence and our collective clinical experience, patients with IBD on advanced therapies (eg, biologics or small molecules) could be able to fast if their disease is in remission, as evidenced by their symptoms, baseline nutritional status, and an acceptable faecal calprotectin level. Those with

	Conditions treated	Risk in fasting	Suggested adjustment
Proton-pump inhibitors (eg, lansoprazole and omeprazole)	Gastro-oesophageal reflux disease, peptic ulcer disease, and gastritis	Reduced efficacy if dose taken immediately before or after food; proton-pump inhibitors are most effective after a prolonged fast[90]	Dose should be taken on an empty stomach, and normally in the morning (30 min before Suhoor would be most effective; can be taken 30 min before Iftar)
Steroids (eg, prednisolone and budesonide)	Active colitis and autoimmune hepatitis; after liver transplantation	Risk of a flare of the underlying inflammatory condition if dose missed; risk of rejection if missed	If on steroids for active flare, suggest avoiding fasting and continuing normal drug regimen; if on a long-term low dose (≤10 mg) of maintenance steroids (eg, for autoimmune hepatitis), take during non-fasting hours; if stable graft but still on steroids, then take during non-fasting hours
Tacrolimus	After liver transplantation	High risk of acute kidney injury if dehydrated; risk of rejection if doses missed	If stable graft and more than 12 months post-transplantation: take tacrolimus twice daily (during non-fasting hours) with adequate hydration (at least 2–3 L of water), or if fasting for >12 h consider swapping to once-daily prolonged-release formulations that can be taken 1–2 h before Suhoor[91]
Everolimus or sirolimus	After liver transplantation	Risk of rejection if doses missed	If stable graft and more than 12 months post-transplantation: once-daily dosing can be taken during non-fasting hours
Mycophenolate mofetil	After liver transplantation and autoimmune hepatitis	High risk of rejection or relapse if doses missed	If stable graft and more than 12 months post-transplantation: take mycophenolate mofetil twice daily (during non-fasting hours) with adequate hydration (at least 2–3 L of water), or if fasting for >12 h consider swapping to low-dose prednisolone[92]
Mesalazine (including oral and per-rectal preparations)	IBD	Missed doses resulting in a risk of a flare	Patients can be switched to once-daily formulations if mild colitis or quiescent disease[87]
Mercaptopurine	Autoimmune hepatitis and IBD	Risk of a flare of the underlying inflammatory condition if doses missed	Once-daily dose can be taken with food or on an empty stomach during non-fasting hours (eg, at Suhoor or Iftar)
Azathioprine	Autoimmune hepatitis and IBD	Risk of a flare of the underlying inflammatory condition if doses missed	Normally once-daily dosing; take during non-fasting hours (eg, at Suhoor or Iftar)
Methotrexate	IBD	Risk of a flare of the underlying inflammatory condition if doses missed	Oral or subcutaneous preparations, used once weekly; timing can be adjusted around Suhoor or Iftar
Biologics (eg, infliximab, adalimumab, vedolizumab, mirikizumab, risankizumab, ustekinumab, and golimumab)	IBD	Risk of a flare or complications due to the underlying inflammatory condition if doses missed	Intravenous or subcutaneous preparations are normally given at intervals of ≥1 week in the maintenance phase; timing can be adjusted around Suhoor or Iftar; if facilities are not available to change the timings, then discuss with the health-care professional; avoid fasting if active IBD requires a change of biologic or initiation of a new biologic
Small molecule drugs (eg, tofacitinib, upadacitinib, filgotinib, and ozanimod)	IBD	High risk of a flare or complications if doses missed	Oral preparations to be taken once or twice daily; take during non-fasting hours (eg, at Suhoor, Iftar, or both)
Creon	Pancreatic insufficiency due to pancreatitis	Malabsorption and abdominal symptoms if doses missed	Therapy should be taken with food: with meals at Suhoor or Iftar, and with snacks after Iftar (if any further doses required)
Lactulose	Constipation	Constipation	Can be taken during non-fasting hours (eg,at Suhoor or Iftar)
Rifaximin	Traveller's diarrhoea	Worsening of diarrhoea	Can be taken during non-fasting hours (eg, at Suhoor or Iftar)
Codeine	High-output stoma	Worsening of stoma output	Dose varies between two and four times per day; can be taken during non-fasting hours (eg, at Suhoor and Iftar) if twice daily; avoid fasting if dosing is needed more than twice daily for a high-output stoma
Loperamide	High-output stoma	Worsening of stoma output	Dose varies between two and four times per day; can be taken before Suhoor and after Iftar if twice daily; avoid fasting if dosing is needed more than twice daily for a high-output stoma
Ursodeoxycholic acid	Dissolution of gallstones, primary biliary cholangitis, and bile reflux gastritis	Inadequate dissolution of gallstones, progression of primary biliary cholangitis, and worsening of bile reflux gastritis if doses missed	Can be changed to twice-daily dosing regimen, to be taken during non-fasting hours (eg, at Suhoor or Iftar)
Non-selective β-blocker (eg, carvedilol)	Prevention of bleeding in medium to large oesophageal varices	High risk of upper gastrointestinal bleeding if doses missed	Once or twice-daily dose can be taken during non-fasting hours (eg, at Suhoor, Iftar, or both), provided systolic blood pressure is >90 mm Hg and heart rate is >55 beats per min
Direct-acting antivirals (eg, sofosbuvir-containing regimens)	Chronic hepatitis C virus infection	Inadequate response if doses missed	Once-daily dose can be taken during non-fasting hours (eg, at Suhoor or Iftar); consider interactions with medicines such as proton-pump inhibitors and consider dose spacing (eg, take proton-pump inhibitors at Suhoor and direct-acting antivirals at Iftar)
Nucleoside or nucleotide analogues (eg, tenofovir)	Chronic hepatitis B virus infection	Inadequate response if doses missed	Once-daily dose can be taken during non-fasting hours (eg, at Suhoor or Iftar)

IBD=inflammatory bowel disease.

Table 2: **Suggested changes in medication of commonly used drugs for gastrointestinal and hepatobiliary conditions**

stable IBD on multiple daily doses of mesalazine could be safely switched to once-daily regimens.[87]

We believe it is unsafe for patients with active IBD (as defined by increased symptoms, elevated faecal calprotectin, and endoscopic or radiological findings of disease activity) to fast due to the increased risk of complications, including dehydration, malnutrition, thromboembolic conditions, and electrolyte imbalances, during IBD flares.[88]

Other luminal conditions

Based on our clinical experience, individuals with irritable bowel syndrome could fast provided they make appropriate lifestyle and dietary modifications to their routines during Ramadan, such as those suggested by the British Dietetic Association.[89]

For luminal conditions with sparse data on the effects of RIF, we base our recommendations on the risk of dehydration from ongoing diarrhoea or malnutrition related to the condition. Thus, we recommend that patients with coeliac disease, microscopic colitis, and bile acid malabsorption without ongoing diarrhoea, and patients with a stoma without high output (high output defined as >1 L per 24 h), could safely fast. However, due to the risk of dehydration and malnutrition, people on parenteral nutrition must not fast.

Recommendations on commonly used medications

Table 2 provides an outline of the commonly used medications for gastrointestinal and hepatobiliary conditions, their associated risks during RIF, and suggested adjustments for RIF, where reasonable. Modifications can include switching to once-daily prolonged-release formulations when fasting for longer than 12 h. For example, patients with stable IBD could be swapped to once-daily formulations of mesalazine. Similarly, for stable liver transplant recipients who are more than 12 months post-transplantation, once-daily prolonged-release formulations of calcineurin inhibitors might be an option, or the use of once-daily azathioprine over twice-daily mycophenolate mofetil. Medication reviews should be undertaken at least 1 month before Ramadan to allow for optimisation.

Alternative arrangements: trial fasting

If patients in the categories of high and very high risk still wish to fast, we suggest that they attempt some days of trial fasting 1 month before Ramadan to establish the suitability and tolerability of fasting. The approach to trial fasting has been described elsewhere.[2]

Alternative arrangements: winter fasting

In some regions, the time between dawn and dusk can be between 8 h and 10 h during the winter months (compared with >12 h during summer). It might be more suitable for patients to compensate for the lost RIF days during this time, particularly for those at high and very high risk.[21]

Limitations

The primary focus of this Review was to present a broad perspective on RIF in patients with gastrointestinal and hepatobiliary conditions, identify key themes, and discuss the current state of knowledge. Although we recognise the importance of grading the strength of recommendations and conducting formal quality assessments of individual studies in systematic reviews, doing so was beyond the scope of our narrative Review. There is a paucity of well controlled studies on the effects of RIF on gastrointestinal and hepatobiliary conditions. The evidence is often observational, weak, underpowered, and biased, failing to consider the confounding effects of variations in diets and other lifestyle changes associated with Ramadan (eg, sleep), hours of fasting, adherence to fasting, and comorbidities. We provide practical recommendations while acknowledging these limitations. Our risk stratification approach builds on the IDF–DAR model for RIF in people with diabetes.[18] Although this model has not been specifically validated in patients with gastrointestinal or hepatobiliary conditions, it is a well established tool for developing evidence-based recommendations and has been applied previously to narrative reviews on Ramadan fasting for other non-gastrointestinal conditions. We recognise that a formal Delphi consensus of experts could have allowed more granular

Search strategy and selection criteria

An initial literature search was performed using PubMed, Embase, and Google Scholar, first between March 15, 2023, and April 30, 2023, with the assistance of an academic librarian, and subsequently repeated between Nov 15, 2023, and Nov 30, 2023. We searched for articles assessing the effects of Ramadan intermittent fasting (RIF) on human and animal physiology and clinical outcomes related to gastrointestinal and hepatobiliary conditions published in English between database inception and Nov 30, 2023. To expand the scope of our evidence, we also included studies on other forms of intermittent fasting, acknowledging that these forms might differ from RIF, especially concerning hydration and sleep disruption. Studies were excluded if they did not specifically evaluate outcomes related to fasting in human participants with gastrointestinal or hepatobiliary disorders or animal subjects with modelled disorders. Search terms included: "Intermittent fasting", "fasting", "Ramadan", "Ramazan", "Ramadhan", "Islamic fasting", "restricted feeding", "gastrointestinal disease", "liver cirrhosis", "NAFLD", "Non-alcoholic fatty liver disease ", "Hepatitis", "iron overload ", "hemochromatosis", "Wilson's disease ", "copper overload ", " cholangiopathies", "autoimmune hepatitis", "primary biliary cholangitis", "primary sclerosing cholangitis ", "hepatocellular carcinoma ", "acute pancreatitis", "chronic pancreatitis", "Inflammatory bowel disease", "alpha-1 antitrypsin deficiency", "Crohn's disease", "ulcerative colitis", "GERD", "GORD", "Gastroesophageal reflux", "IBS", "coeliac disease", "celiac disease", "bile acid malabsorption", "stoma", "microscopic colitis", "parenteral nutrition", and "irritable bowel". We focused on common gastrointestinal and hepatobiliary conditions in which periods of fasting might plausibly alter disease course and outcomes, whether positively or negatively. Despite the contemporary preferred nomenclature of metabolic dysfunction-associated steatotic liver disease (MASLD) and metabolic dysfunction-associated steatohepatitis (MASH), the reviewed literature exclusively used non-alcoholic fatty liver disease (NAFLD) and non-alcoholic steatohepatitis (NASH) terminologies. Therefore, for consistency with previous literature, this Review used "NAFLD" and "NASH" as search terms. Further articles were identified through snowballing.

recommendations customised to gastrointestinal and hepatobiliary conditions. We also acknowledge the absence of religious scholarly input in this Review, as we consciously focused the discussion and advice on medical considerations. Additionally, although we focused on common gastrointestinal and hepatobiliary conditions, comorbidities not discussed in this Review could affect the safety of fasting during Ramadan.

Conclusion

In this Review, we analysed the existing evidence on the management of common gastrointestinal and hepatobiliary conditions during the fasting month of Ramadan. We provide a risk stratification model to identify patients with gastrointestinal and hepatobiliary conditions who might be at risk of harm from RIF and discuss practical recommendations to minimise the risk for those who wish to fast. Shared decision making is essential, with risks and benefits carefully weighed on an individual basis. With careful management, many patients with gastrointestinal and hepatobiliary conditions can safely fast during Ramadan, but those at high risk of complications might need to abstain from fasting and consider alternative arrangements. There is a need for further studies examining the influence of RIF on the activity and outcomes of gastrointestinal and hepatobiliary diseases.

Contributors

NG, AJ, SW, and MFP conceptualised the study and designed the methodology. MU, NJ, AJ, SW, MQK, and MFP were involved in data analysis. MU and NJ equally contributed to the manuscript, curated the data, and wrote the original drafts of the manuscript; all authors contributed to review and editing of subsequent drafts. MFP, SW, MQK, and NG supervised the study. All authors verified and consented to the published version of the manuscript, and accept the responsibility to submit the manuscript for publication.

Declaration of interests

AH has served as consultant, advisory board member, or speaker for AbbVie, Arena, Atlantic, Bristol Myers Squibb, Celgene, Celltrion, Falk, Galapogos, Lilly, Janssen, MSD, Napp Pharmaceuticals, Pfizer, Pharmacosmos, Shire, Takeda, Gentech, and Roche. BH declares research grants from Gilead, Intercept, Novo Nordisk, Pliant, Salix, and Madrigal; is an advisory board member for Mallinckrodt and Pleiogenix; has provided consultation services to Gilead, Pioneering Medicine VII, and Surrozen; and has stock options in Pleiogenix. MFP declares payment or honoraria for lectures, presentations, or educational events from Takeda, Bristol Myers Squibb, and Janssen; and has received support for attending meetings from Takeda and Galapagos. All other authors declare no competing interests.

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References

1 Ghani F. Most Muslims say they fast during Ramadan. July 9, 2023. https://policycommons.net/artifacts/621508/most-muslims-say-they-fast-during-ramadan/1602734/ (accessed July 29, 2023).
2 Mahmood A, Dar S, Dabhad A, Aksi B, Chowdhury TA. Advising patients with existing conditions about fasting during Ramadan. *BMJ* 2022; **376:** e063613.
3 de Cabo R, Mattson MP. Effects of intermittent fasting on health, aging, and disease. *N Engl J Med* 2019; **381:** 2541–51.
4 Patterson RE, Sears DD. Metabolic effects of intermittent fasting. *Annu Rev Nutr* 2017; **37:** 371–93.
5 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.
6 Elmajnoun HK, Faris ME, Abdelrahim DN, Haris PI, Abu-Median AB. Effects of Ramadan fasting on glycaemic control among patients with type 2 diabetes: systematic review and meta-analysis of observational studies. *Diabetes Ther* 2023; **14:** 479–96.
7 Faris MA, Jahrami H, BaHammam A, Kalaji Z, Madkour M, Hassanein M. A systematic review, meta-analysis, and meta-regression of the impact of diurnal intermittent fasting during Ramadan on glucometabolic markers in healthy subjects. *Diabetes Res Clin Pract* 2020; **165:** 108226.
8 Al-Jafar R, Zografou Themeli M, Zaman S, et al. Effect of religious fasting in Ramadan on blood pressure: results from LORANS (London Ramadan study) and a meta-analysis. *J Am Heart Assoc* 2021; **10:** e021560.
9 Faris M, Jahrami H, Abdelrahim D, Bragazzi N, BaHammam A. The effects of Ramadan intermittent fasting on liver function in healthy adults: a systematic review, meta-analysis, and meta-regression. *Diabetes Res Clin Pract* 2021; **178:** 108951.
10 Aadil N, Houti IE, Moussamih S. Drug intake during Ramadan. *BMJ* 2004; **329:** 778–82.
11 Abolaban H, Al-Moujahed A. Muslim patients in Ramadan: a review for primary care physicians. *Avicenna J Med* 2017; **7:** 81–87.
12 Ghouri N, Hussain S, Mohammed R, et al. Diabetes, driving and fasting during Ramadan: the interplay between secular and religious law. *BMJ Open Diabetes Res Care* 2018; **6:** e000520.
13 Babineaux SM, Toaima D, Boye KS, 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.
14 Aslam M, Assad A. Drug regimens and fasting during Ramadan: a survey in Kuwait. *Public Health* 1986; **100:** 49–53.
15 Hassanein M, Afandi B, Yakoob Ahmedani M, et al. Diabetes and Ramadan: practical guidelines 2021. *Diabetes Res Clin Pract* 2022; **185:** 109185.
16 Hussain S, Choudhary P, Hopkins D. Type 1 diabetes and fasting in Ramadan: time to rethink classification of risk? *Lancet Diabetes Endocrinol* 2020; **8:** 656–58.
17 Terry G, Hayfield N, Clarke V, Braun V. Thematic analysis. In: Willig C, Stainton Rogers W, eds. The SAGE handbook of qualitative research in psychology, second edition. London: SAGE Publications, 2017: 17–37.
18 Hassanein M, Afandi B, Ahmedani MY, et al. Diabetes and Ramadan: practical guidelines 2021. *Diabetes Res Clin Pract* 2022; **185:** 109185.
19 Ahmed SH, Chowdhury TA, Hussain S, et al. Ramadan and diabetes: a narrative review and practice update. *Diabetes Ther* 2020; **11:** 2477–520.
20 Hussain S, Hussain S, Mohammed R, Meeran K, Ghouri N. Fasting with adrenal insufficiency: practical guidance for healthcare professionals managing patients on steroids during Ramadan. *Clin Endocrinol* 2020; **93:** 87–96.
21 Akhtar AM, Ghouri N, Chahal CAA, et al. Ramadan fasting: recommendations for patients with cardiovascular disease. *Heart* 2022; **108:** 258–65.
22 Malik S, Bhanji A, Abuleiss H, et al. Effects of fasting on patients with chronic kidney disease during Ramadan and practical guidance for healthcare professionals. *Clin Kidney J* 2021; **14:** 1524–34.
23 Malik S, Hamer R, Shabir S, et al. Effects of fasting on solid organ transplant recipients during Ramadan—a practical guide for healthcare professionals. *Clin Med* 2021; **21:** e492–98.
24 Ghouri N, Hussain S, Ahmed SH, et al. Changing how we risk-categorise in Ramadan: does the IDF-DAR scoring system achieve the requirements for people with diabetes internationally? *Diabetes Res Clin Pract* 2021; **175:** 108835.
25 Shamsi N, Naser J, Humaidan H, et al. Verification of 2021 IDF-DAR risk assessment tool for fasting Ramadan in patients with diabetes attending primary health care in the Kingdom of Bahrain: the DAR-BAH study. *Diabetes Res Clin Pract* 2024; **211:** 111661.

26 Lin JF, Chen JM, Zuo JH, et al. Meta-analysis: fecal calprotectin for assessment of inflammatory bowel disease activity. *Inflamm Bowel Dis* 2014; **20:** 1407–15.

27 Younossi ZM, Golabi P, Paik JM, Henry A, Van Dongen C, Henry L. The global epidemiology of nonalcoholic fatty liver disease (NAFLD) and nonalcoholic steatohepatitis (NASH): a systematic review. *Hepatology* 2023; **77:** 1335–47.

28 Arabi SM, Hejri Zarifi S, Nematy M, Safarian M. The effect of Ramadan fasting on non-alcoholic fatty liver disease (NAFLD) patients. *J Nutr Fast Health* 2015; **3:** 74–80.

29 Rahimi H, Habibi ME, Gharavinia A, Emami MH, Baghaei A, Tavakol N. Effect of Ramadan fasting on alanine transferase (ALT) in nonalcoholic fatty liver disease (NAFLD). *J Nutr Fast Health* 2017; **5:** 107–12.

30 Ebrahimi S, Gargari BP, Izadi A, Imani B, Asjodi F. The effects of Ramadan fasting on serum concentrations of vaspin and omentin-1 in patients with nonalcoholic fatty liver disease. *Eur J Integr Med* 2018; **19:** 110–14.

31 Ebrahimi S, Gargari BP, Aliasghari F, Asjodi F, Izadi A. Ramadan fasting improves liver function and total cholesterol in patients with nonalcoholic fatty liver disease. *Int J Vitam Nutr Res* 2020; **90:** 95–102.

32 Mindikoglu AL, Opekun AR, Gagan SK, Devaraj S. Impact of time-restricted feeding and dawn-to-sunset fasting on circadian rhythm, obesity, metabolic syndrome, and nonalcoholic fatty liver disease. *Gastroenterol Res Pract* 2017; **2017:** 3932491.

33 Aliasghari F, Izadi A, Gargari BP, Ebrahimi S. The effects of Ramadan fasting on body composition, blood pressure, glucose metabolism, and markers of inflammation in NAFLD patients: an observational trial. *J Am Coll Nutr* 2017; **36:** 640–45.

34 Alasmari AA, Al-Khalifah AS, BaHammam AS, et al. Ramadan fasting model exerts hepatoprotective, anti-obesity, and anti-hyperlipidemic effects in an experimentally-induced nonalcoholic fatty liver in rats. *Saudi J Gastroenterol* 2023; **30:** 53–62.

35 Cai H, Qin YL, Shi ZY, et al. Effects of alternate-day fasting on body weight and dyslipidaemia in patients with non-alcoholic fatty liver disease: a randomised controlled trial. *BMC Gastroenterol* 2019; **19:** 219.

36 Mari A, Khoury T, Baker M, Said Ahmad H, Abu Baker F, Mahamid M. The impact of Ramadan fasting on fatty liver disease severity: a retrospective case control study from Israel. *Isr Med Assoc J* 2021; **23:** 94–98.

37 Gad AI, Abdel-Ghani HA, Barakat AAEA. Effect of Ramadan fasting on hepatic steatosis as quantified by controlled attenuation parameter (CAP): a prospective observational study. *Egypt Liver J* 2022; **12:** 1–7.

38 Elnadry MH, Nigm IA, Abdel Aziz IM, et al. Effect of Ramadan fasting on Muslim patients with chronic liver diseases. *J Egypt Soc Parasitol* 2011; **41:** 337–46.

39 Elfret A, Abousaif S, Kader NA, et al. A multicenter pilot study of the effects of Ramadan fasting on patients with liver cirrhosis. *Tanta Med Sci J* 2011; **6:** 33–36.

40 Mohamed SY, Emara MH, Hussien HI, Elsadek HM. Changes in portal blood flow and liver functions in cirrhotics during Ramadan fasting in the summer; a pilot study. *Gastroenterol Hepatol Bed Bench* 2016; **9:** 180–88.

41 Mohamed SY, Emara MH, Gabballah BA, Mostafa EF, Maaly MA. Effects of Ramadan fasting on Muslim patients with liver cirrhosis: a comparative study. *Govaresh* 2018; **23:** 47–52.

42 Iraki L, Bogdan A, Hakkou F, Amrani N, Abkari A, Touitou Y. Ramadan diet restrictions modify the circadian time structure in humans. A study on plasma gastrin, insulin, glucose, and calcium and on gastric pH. *J Clin Endocrinol Metab* 1997; **82:** 1261–73.

43 Mardhiyah R, Makmun D, Syam AF, Setiati S. The effects of Ramadhan fasting on clinical symptoms in patients with gastroesophageal reflux disease. *Acta Med Indones* 2016; **48:** 169–74.

44 Bohamad AH, Aladhab WA, Alhashem SS, et al. Impact of Ramadan fasting on the severity of symptoms among a cohort of patients with gastroesophageal reflux disease (GERD). *Cureus* 2023; **15:** e36831.

45 Chandra E, Ndraha S, Wibawa I. Effect of omeprazole to dyspeptic symptom on Ramadan fasting patient based on Dyspepsia Symptoms Severity Index scores. *Indones J Gastroenterol Hepatol Dig Endosc* 2013; **14:** 69–72.

46 Hamdan AL, Nassar J, Dowli A, Al Zaghal Z, Sabri A. Effect of fasting on laryngopharyngeal reflux disease in male subjects. *Eur Arch Otorhinolaryngol* 2012; **269:** 2361–66.

47 Kocakusak A. Does Ramadan fasting contribute to the increase of peptic ulcer perforations? *Eur Rev Med Pharmacol Sci* 2017; **21:** 150–54.

48 Bener A, Derbala MF, Al-Kaabi S, et al. Frequency of peptic ulcer disease during and after Ramadan in a United Arab Emirates hospital. *East Mediterr Health J* 2006; **12:** 105–11.

49 Dönderici O, Temizhan A, Küçükbaş T, Eskioğlu E. Effect of Ramadan on peptic ulcer complications. *Scand J Gastroenterol* 1994; **29:** 603–06.

50 Gokakin AK, Kurt A, Akgol G, et al. Effects of Ramadan fasting on peptic ulcer disease as diagnosed by upper gastrointestinal endoscopy. *Arab J Gastroenterol* 2012; **13:** 180–83.

51 Tavakkoli H, Haghdani S, Emami MH, Adilipour H, Tavakkoli M, Tavakkoli M. Ramadan fasting and inflammatory bowel disease. *Indian J Gastroenterol* 2008; **27:** 239–41.

52 Negm M, Bahaa A, Farrag A, et al. Effect of Ramadan intermittent fasting on inflammatory markers, disease severity, depression, and quality of life in patients with inflammatory bowel diseases: a prospective cohort study. *BMC Gastroenterol* 2022; **22:** 203.

53 Lai JC, Tandon P, Bernal W, et al. Malnutrition, frailty, and sarcopenia in patients with cirrhosis: 2021 practice guidance by the American Association for the Study of Liver Diseases. *Hepatology* 2021; **74:** 1611–44.

54 Amodio P, Bemeur C, Butterworth R, et al. The nutritional management of hepatic encephalopathy in patients with cirrhosis: International Society for Hepatic Encephalopathy and Nitrogen Metabolism consensus. *Hepatology* 2013; **58:** 325–36.

55 Plank LD, Gane EJ, Peng S, et al. Nocturnal nutritional supplementation improves total body protein status of patients with liver cirrhosis: a randomized 12-month trial. *Hepatology* 2008; **48:** 557–66.

56 Haag K, Rössle M, Ochs A, et al. Correlation of duplex sonography findings and portal pressure in 375 patients with portal hypertension. *AJR Am J Roentgenol* 1999; **172:** 631–35.

57 Derbala M, Elbadri M, Amer A, et al. Safety and deleterious effect of fasting Ramadan in liver transplant recipients. *J Gastroenterol Metabol* 2018; **1:** 301.

58 Montasser IF, Dabbous H, Sakr MM, et al. Effect of Ramadan fasting on Muslim recipients after living donor liver transplantation: a single center study. *Arab J Gastroenterol* 2020; **21:** 76–79.

59 Emara MH, Soliman HH, Elnadry M, et al. Ramadan fasting and liver diseases: a review with practice advices and recommendations. *Liver Int* 2021; **41:** 436–48.

60 Staff Members of Tropical Medicine Department, Faculty of Medicine, Zagazig University, Egypt. Liver disease and fasting during the month of Ramadan. *Afro-Egypt J Infect Endem Dis* 2014; **4:** 112–13.

61 Adzharov D, Donchev N, Kerimova M, Naĭdenova E, Borov B. Effects of preliminary fasting on the development of D-galactosamine-induced acute lesion of the liver in rats. *Biull Eksp Biol Med* 1989; **107:** 33–36.

62 Li L, Oropeza CE, Kaestner KH, McLachlan A. Limited effects of fasting on hepatitis B virus (HBV) biosynthesis in HBV transgenic mice. *J Virol* 2009; **83:** 1682–88.

63 Becker S, Momoh J, Biancacci I, et al. Intermittent fasting primes the tumor microenvironment and improves nanomedicine delivery in hepatocellular carcinoma. *Small* 2023; **19:** e2208042.

64 Qi J, Chen X, Wu Q, et al. Fasting induces hepatocellular carcinoma cell apoptosis by inhibiting SET8 expression. *Oxid Med Cell Longev* 2020; **2020:** 3985089.

65 Minciuna I, van Kleef LA, Stefanescu H, Procopet B. Is fasting good when one is at risk of liver cancer? *Cancers (Basel)* 2022; **14:** 5084.

66 Krstic J, Reinisch I, Schindlmaier K, et al. Fasting improves therapeutic response in hepatocellular carcinoma through p53-dependent metabolic synergism. *Sci Adv* 2022; **8:** eabh2635.

67 Drozdinsky G, Agabaria A, Zuker-Herman R, J Drescher M, Bleetman T, Shiber S. High rate of acute pancreatitis during the Ramadan fast. *Eur J Gastroenterol Hepatol* 2018; **30:** 608–11.

68 Yoshinaga K, Washizuka M, Segawa Y. Fasting exacerbates acute pancreatitis by occlusion of the common bile duct in rats. *Jpn J Pharmacol* 2000; **84:** 455–61.

69 Magnuson TH, Ahrendt SA, Lillemoe KD, Kaufman HS, Watt PC, Pitt HA. Short-term fasting increases biliary calcium and bilirubin. *J Surg Res* 1991; **50:** 529–34.

70 Huyut Z, Arihan O. Effect of intermittent fasting during acrylamide exposure on blood copper, zinc and lead levels in rats. *East J Med* 2018; **23:** 242–46.

71 Ashraf W, van Someren N, Quigley EM, Saboor SA, Farrow LJ. Gilbert's syndrome and Ramadan: exacerbation of unconjugated hyperbilirubinemia by religious fasting. *J Clin Gastroenterol* 1994; **19:** 122–24.

72 Kamal S, Abdelhakam S, Ghoraba D, et al. The frequency, clinical course, and health related quality of life in adults with Gilbert's syndrome: a longitudinal study. *BMC Gastroenterol* 2019; **19:** 22.

73 Zhang M, Hou ZK, Huang ZB, Chen XL, Liu FB. Dietary and lifestyle factors related to gastroesophageal reflux disease: a systematic review. *Ther Clin Risk Manag* 2021; **17:** 305–23.

74 Voigt RM, Forsyth CB, Keshavarzian A. Circadian rhythms: a regulator of gastrointestinal health and dysfunction. *Expert Rev Gastroenterol Hepatol* 2019; **13:** 411–24.68

75 Dickman R, Green C, Fass SS, et al. Relationships between sleep quality and pH monitoring findings in persons with gastroesophageal reflux disease. *J Clin Sleep Med* 2007; **3:** 505–13.

76 Vaughn BV, Rotolo S, Roth H. Circadian rhythm and sleep influences on digestive physiology and disorders. *ChronoPhysiology and Therapy* 2014; **4:** 67–77.

77 Rangan P, Choi I, Wei M, et al. Fasting-mimicking diet modulates microbiota and promotes intestinal regeneration to reduce inflammatory bowel disease pathology. *Cell Rep* 2019; **26:** 2704–19.

78 Song S, Bai M, Ling Z, Lin Y, Wang S, Chen Y. Intermittent administration of a fasting-mimicking diet reduces intestinal inflammation and promotes repair to ameliorate inflammatory bowel disease in mice. *J Nutr Biochem* 2021; **96:** 108785.

79 Ikbal BSN, Ayfer BSN, Nuray BSN, Yildiz BSN, Yasemin BSN. Religious worship in patients with abdominal stoma: praying and fasting during Ramadan. *Int J Caring Sci* 2013; **6:** 516–21.

80 Kuzu MA, Topçu O, Uçar K, et al. Effect of sphincter-sacrificing surgery for rectal carcinoma on quality of life in Muslim patients. *Dis Colon Rectum* 2002; **45:** 1359–66.

81 Altuntas YE, Gezen FC, Sahoniz T, et al. Ramadan fasting in patients with a stoma: a prospective study of quality of life and nutritional status. *Ostomy Wound Manage* 2013; **59:** 26–32.

82 Madkour MI, Hassan RE, Sherif NM, et al. Haptoglobin polymorphism modulates cardiometabolic impacts of four consecutive weeks, dawn to sunset Ramadan intermittent fasting among subjects with overweight/obesity. *Diabetes Res Clin Pract* 2022; **190:** 110024.

83 Merli M, Berzigotti A, Zelber-Sagi S, et al. EASL Clinical Practice Guidelines on nutrition in chronic liver disease. *J Hepatol* 2019; **70:** 172–93.

84 Islam Question & Answer. Does your fast break if you bleed? https://islamqa.info/en/answers/37918/does-your-fast-break-if-you-bleed (accessed June 13, 2024).

85 Ozkan S, Durukan P, Akdur O, Vardar A, Torun E, Ikizceli I. Does Ramadan fasting increase acute upper gastrointestinal haemorrhage? *J Int Med Res* 2009; **37:** 1988–93.

86 Amine M, Kaoutar S, Ihssane M, Adil I, Dafr-Allah B. Effect of Ramadan fasting on acute upper gastrointestinal bleeding. *J Res Med Sci* 2013; **18:** 230–33.

87 Dignass AU, Bokemeyer B, Adamek H, et al. Mesalamine once daily is more effective than twice daily in patients with quiescent ulcerative colitis. *Clin Gastroenterol Hepatol* 2009; **7:** 762–69.

88 Ünal NG, Oruç N, Tomey O, Ömer Özütemiz A. Malnutrition and sarcopenia are prevalent among inflammatory bowel disease patients with clinical remission. *Eur J Gastroenterol Hepatol* 2021; **33:** 1367–75.

89 British Dietetic Association. Ramadan and diet. April 1, 2022. https://www.bda.uk.com/resource/ramadan-and-diet.html (accessed Aug 13, 2024).

90 Wolfe MM, Sachs G. Acid suppression: optimizing therapy for gastroduodenal ulcer healing, gastroesophageal reflux disease, and stress-related erosive syndrome. *Gastroenterology* 2000; **118** (suppl 1): S9–31.

91 Bzeizi KI, Albenmousa A, Shawkat AM, et al. Efficacy and safety of once daily tacrolimus compared to twice daily tacrolimus after liver transplantation. *World J Hepatol* 2021; **13:** 375–83.

92 Moini M, Schilsky ML, Tichy EM. Review on immunosuppression in liver transplantation. *World J Hepatol* 2015; **7:** 1355–68.

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