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SURGERY FOR OBESITY AND RELATED DISEASES

ASMBS Guidelines/Statements

American Society for Metabolic and Bariatric Surgery review on fasting for religious purposes after surgery

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Preamble

This review article is issued by the American Society for Metabolic and Bariatric Surgery (ASMBS) in response to numerous inquiries made to ASMBS by patients, physicians, ASMBS members, hospitals, health insurance payors, the media, and others regarding the safety and recommendations for fasting for religious purposes after undergoing metabolic and bariatric surgery. In this article, a summary of published, peer-reviewed scientific evidence spanning the years from 2000 to 2020 and a recently published 2021 Delphi Consensus and expert opinion is presented. The intent of issuing such a review is to provide available objective information about this topic. Unfortunately, there is a lack of published research on the effects of religious fasting on metabolic and bariatric surgery (MBS); therefore, the majority of the reviewed literature covers the effects of religious fasting on adults who have not undergone MBS. For the purpose of this review, guidance is given for religious fasting for spiritual, health, and safety benefits after bariatric surgery but not for using fasting as a weight loss strategy in the adult population. In addition, because of the absence of research on adolescents and children undergoing MBS and fasting, this review focuses on summarizing literature regarding adults and making recommendations for adults who underwent MBS and desire to fast. This review is not intended as and should not be construed as stating or establishing a local, regional, or national standard of care. This review article will be revised in the future as additional evidence becomes available.

Fasting is defined as the willful partial or total abstinence from food and beverage or select omission of prohibited foods [1]. The 3 broad categories of dietary fasting are (1)

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calorie restriction (CR): deliberate reduction of calories by 20%–40% [1,2]; (2) alternate-date fasting (ADF): alternating a feast with a fast, whereby the feast period allows ad libitum food intake and the fast restricts food and beverage [1] (water may or may not be allowed during the fasting period); and (3) dietary restriction (DR): omitting 1 or more components of the diet, such as certain macronutrients or elements of macronutrients [1].

Concerns with fasting after bariatric surgery are increased risk of dehydration, inadequate intake of macronutrients (specifically protein, which can lead to loss of lean body mass), exacerbation of food intolerance (with potential changes in diet macronutrient composition), inadequate intake of micronutrients (which can lead to nutritional deficiencies), and effect on psychosocial conditions. Severity of risk could be influenced by the surgical procedure and the time after surgery one observes the fast, whether in the immediate perioperative period (24–30 d), within 6–12 months postoperatively, or after 1 year from the bariatric procedure.

Religious Fasting Traditions

Religious practices and cultural traditions are an integral part of human life that can have a significant effect on the health of an individual and community. Fasting is a practice found in nearly all cultures and religions across the world. Although fasting can take many forms, the religious fasting traditions are likely the most rigorous and best studied in terms of health [1]. This review focuses on 3 such practices: the Islamic fast during the month of Ramadan, the Greek Orthodox Christian fast, and the Daniel biblical fast. Given the available published research, much of this literature review will focus on Ramadan fasting and the implications it may have for the bariatric population.

Ramadan

Ramadan is the ninth month of the Islamic lunar calendar. Among other spiritual and religious activities during Ramadan that include contemplation, prayer, and reflection on the word of God, Muslims fast from dawn to dusk each day of the month in pursuit of self-discipline, connectivity with humanity's needs, and appreciation of its Creator. Because the lunar calendar year is shorter than the solar-based Gregorian calendar year, the actual start date of Ramadan is 10–12 days earlier each year, and thus the month falls on different parts of the seasonal year. Depending on the synodic period of the moon's orbit (from crescent to crescent), geographic location, and solar season, the duration of Ramadan is 29–30 days, and the daily hours of fasting vary. If Ramadan falls during summer in regions north or south of the equator, for example, daytime may last $>$18 hours, extending the fasting duration and possibly increasing the risk of dehydration and hunger. Those who choose to fast often adapt their daily activity to help mitigate some of these effects and better cope with the decreased nutrient and water intake during the day. Fasting during the month of Ramadan is required of all healthy Muslims of able, sound mind and body who have attained the physiologic age of puberty. There are clear exemptions to fasting during Ramadan. Women who are menstruating, pregnant, or breastfeeding and those who are sick, debilitated, or traveling are exempt [1]. Interestingly, Muslims who meet the qualifications of exemption often choose to fast anyway [1].

As it relates to food, the nature of the fast requires complete abstinence from oral intake (food and drink) from dawn until sunset each day for the entire lunar cycle. Food and drink are allowed at libitum through the nighttime hours between sunset and dawn. Specific meal composition and portion sizes during Ramadan often represent a change from the usual baseline for Muslim patients. The evening meal (*Iftar*) breaks the daily fast, and for many it represents the largest calorie intake of the day. Cultural practices during *Iftar* vary, and overeating can occur because consumption of prepared calorie-dense meals rich in fried and sugary foods is frequent [1]. Fasting after MBS can pose challenges. Therefore, it will be helpful for metabolic and bariatric programs to be culturally aware and have guidance for the decision-making process to better educate and prepare their patients who desire to fast after surgery.

Greek Orthodox Christian fasting

Greek Orthodox Christian fasting philosophy merges the Old and New Testaments of the Bible and allows the Christian to become closer to the holiness of God through self-control and discipline. Greek Orthodox Christian fasting generally includes DR, with abstention from dairy products, eggs, fish, olive oil, or meats on various days during fasting times. Fasting duration may be for limited, discrete periods but adding up to as many as 200 total days per year [1]. There is no limitation on oral liquid intake, and as such, there is less concern about exacerbation of dehydration for patients fasting after bariatric surgery. However, in a form of vegetarianism in which the relative amount of carbohydrate intake to protein intake can increase, loss of lean body mass after metabolic and bariatric surgery may be a concern, and weight loss progress may be affected by the high amount of carbohydrate intake [3].

Daniel fast

The Daniel fast is based on the Old Testament book of Daniel. According to this religious text, Daniel was a prophet who chose to undertake various periods of veganism DR to focus on prayer and commune with God. Modern Daniel fasts may extend from 10 to 40 days and can be done at any time, but often they are practiced in January as a clean start for the New Year. The restrictions of the Daniel fast include abstention from animal products,

processed foods, white flour, preservatives, additives, flavorings or sweeteners, caffeine, and alcohol [4]. As with Greek Orthodox fasting, the loss of lean body mass during the weight loss period after MBS is a concern with having restricted intake of complete proteins.

Literature Review

Review of literature using the key search terms such as "fasting and bariatric surgery," "Ramadan fasting," "religious fasting," "fasting after gastric bypass," "fasting after bariatric surgery," "fasting and weight loss surgery," and other combinations was undertaken. A total of 65 records were identified. The literature search on fasting and bariatric surgery produced a total of 4 articles. Included was 1 prospective study [2], a subsequent commentary on that specific published article challenging the methodology and results [5], and a recently published modified Delphi Consensus on religious fasting of Muslim patients after MBS [6]. In addition, there was mention of recommendations for fasting in 1 nutritional clinical practical guideline (CPG) for bariatric surgery by Dagan et al. [7]. The remainder of the research identified fasting in the nonbariatric population and its effect on diabetes, cardiovascular disease, general metabolism and nutrition, and an "other" category, respectively, that included articles on fasting and other effects on human health such as biochemical markers, body composition, eating behaviors, and body image. Fig. 1 depicts the literature review and how many articles were retrieved for each category.

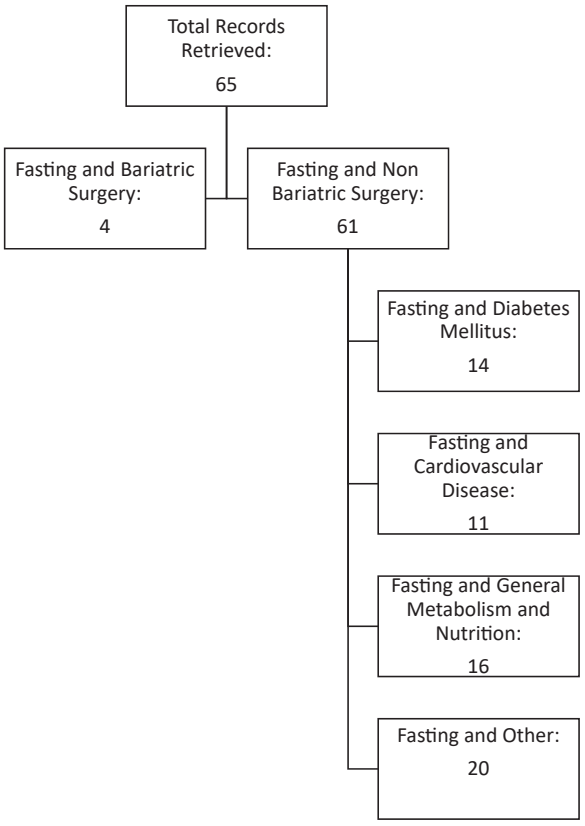

Fig. 1. Literature review.

Fasting and Bariatric Surgery

As mentioned previously, literature on the effects of fasting and MBS is scarce. To date, there is a single prospective study regarding fasting after MBS and a commentary that followed [2,5]. More recently, a modified Delphi Consensus on Ramadan religious fasting after MBS was published [6]. In a prospective study by Al-Ozairi et al. [2], the researchers investigated calorie and nutrient consumption, appetite, satiety, and lifestyle behaviors in male and female patients from Kuwait who had the sleeve gastrectomy (SG) and were fasting for Ramadan. The mean duration since surgery was 14.2 months. Participants were asked details of lifestyle such as physical activity, diet, and adherence to medications and vitamin supplementation during Ramadan. Results showed that there was a slight weight loss after Ramadan fasting in 52.7% of the participants, and there was a weight gain in 17.9% of the participants. No change in weight after Ramadan was seen in 22.7%. More than 89.5% of participants remained compliant with medications. There was no mention of whether patients were compliant with vitamin intake. In terms of diet, there was no significant difference in fluid intake during the fasting time compared with the nonfasting time period. Protein intake was low in both male and female participants. Hunger was perceived as reduced on the day of fasting, and women reported greater satiety than men. Both men and women expressed a desire for savory foods. There was no significant difference in occurrence of complications such as abdominal pain, bloating, diarrhea, hypoglycemia, or constipation during fasting compared with nonfasting.

The authors concluded that prolonged fasting after SG is well tolerated but emphasized the need to educate patients on the importance of protein intake and medication adherence. In a commentary, Tabatabaie et al. [5] remarked on the lack of methodologic rigor in the study, citing potential bias inherent to the survey study design. The commentary states the belief that the conclusions made by Al-Ozairi et al. [2] were overreaching.

The modified Delphi Consensus included 61 surgeons from 24 countries who perform MBS [6]. Forty-five statements regarding aspects of fasting, such as preparation prior to Ramadan, ability to fast, instructions at fasting, risks of fasting, benefits of fasting, exercise during fasting, and disease-specific advice, were determined to be in consensus at $\geq$70%. Interestingly, 100% consensus was attained for the belief that patients who underwent MBS and desire to fast should participate in an interdisciplinary and shared-decision visit by the patient, surgeon, and dietician [6]. Individualized nutritional support during fasting, laboratory

work, and an abdominal ultrasound prior to fasting are recommended. Consensus also was attained at >96% for patients to stop fasting if persistent symptoms of intolerance persist. The recommendation to delay fasting for 6 to 12 months after combined and malabsorptive procedures also reached consensus. Overall, the expert panel agreed that there are many benefits to fasting, but inherent risks and concerns about fasting after MBS require an increased need for patient preparation, education, and support prior to, during, and after fasting [6].

In summary, based on the limited evidence on fasting after MBS, the current research appears to support the idea that fasting after MBS may be safe, but there are inherent risks. The recommendations to delay fasting within the postoperative period to minimize surgery-related and nutritional risks is not in consensus and ranges from 6 to 18 months [6,7]. Patients who underwent MBS and wish to fast should be evaluated, educated, monitored, and supported by the MBS team.

Fasting and Nonbariatric Surgery

The following summarizes the literature review for fasting in non–bariatric surgery populations and its influence on diabetes, cardiovascular disease, metabolism, general nutrition, and other influences on human health such as biochemical markers, body composition, eating behaviors, and body image, respectively.

Fasting and diabetes

The Quran, the Holy Book of Islam, describes exemptions from fasting via the "law of exemption." For example, people who are ill during Ramadan are considered exempt from fasting during their period of illness and can consider other alternatives such as fasting at other times during periods of good health.

In the book, *Caring for Muslim Patients*, the authors of the chapter titled "Managing the Fasting Patient" mention that people with chronic medical conditions, such as diabetes, are excused from fasting, ideally in a concerted decision between the religious leader of the community (Imam) and the patient's healthcare provider [8]. However, patients with diabetes often object to accepting this concession. Gaborit et al. [9] showed that 53% of patients with diabetes chose to fast against the medical advice of their general practitioner, who considered that fasting for them was medically dangerous. This study also demonstrated a large knowledge gap in healthcare providers caring for Muslim patients with diabetes planning to fast for Ramadan [9]. The authors showed that 15% of the general practitioners did not discuss the fast at all, and of those who did, 54% recommended avoiding the fast despite not believing the fast would cause harm [9]. This approach leads to distancing patients from healthcare providers, with patients choosing to fast without appropriate medical consultation [9,10].

The Epidemiology of Diabetes and Ramadan (EPIDIAR) study surveyed 12,914 patients with diabetes in 13 countries with a sizable Muslim population [11]. The study revealed that 42.8% of patients with type 1 diabetes (T1D) and 78.7% with type 2 diabetes (T2D), respectively, fasted for at least 15 days [11]. Based on these findings and others, it is estimated that worldwide, 40–50 million Muslims with diabetes fast during Ramadan, and this underlines the importance of healthcare professionals educating themselves and their patients on safe practices during this time [9–11]. The American Diabetes Association has published guidelines for patient management during Ramadan for those with diabetes [11–13]. The guideline encourages those patients who classify as high risk of developing diabetic complications to be medically dissuaded from fasting. Low- and moderate-risk patients can be allowed to fast with appropriate education, medication adjustment, and follow-up [12–14]. Well-controlled patients with diabetes on oral hypoglycemic medication and/or parenteral insulin regimens are allowed to fast with specific dietary recommendation and medication adjustment. These recommendations were revised and presented as an algorithm by Hui et al. [14] and are currently used to guide patients (Fig. 2). Extending this education to the entire family also has been found to allow more patient compliance and better diabetes outcomes [15].

Diabetes complications in fasting are well known (e.g., hypoglycemia, hyperglycemia, dehydration, diabetic coma, thrombosis), especially in patients treated with oral antidiabetic agents and/or insulin therapy, underscoring again the importance of guidance and education [16]. Several authors have studied the safety of Ramadan fasting in this patient population. In a study by Bravis et al. [16], 57 patients with T2D on oral antidiabetic agents were educated based on American Diabetes Association recommendations (group A), and 54 patients (group B) were not. Group A had a mean weight loss of .7 kg, fewer hypoglycemic events (defined in the study as a home blood glucose measurement of <3.5 mmol/L), and a stable hemoglobin A1C (HbA1C) than the control group. Group B saw a .6 kg mean weight gain, more hypoglycemic events, and a .33% average increase in HbA1C, again, underscoring the benefits of patient guidance and education. M'guil et al. [17] studied 120 patients with well-controlled T2D who received similar diabetic education. No significant differences were recorded in energy intake, blood pressure, total body weight, body mass index (BMI), diabetic control indices (i.e., HbA1C and C-peptide), and lipid profile before, during, and after the fast.

Khaled et al. [18] evaluated 276 demographically matched women with T2D on 1 or 2 antidiabetic medications. An average of 3.12 kg of weight loss was seen during the fast, although BMI, waist circumference, and waist-to-hip ratio (WHR) remained stable before and after

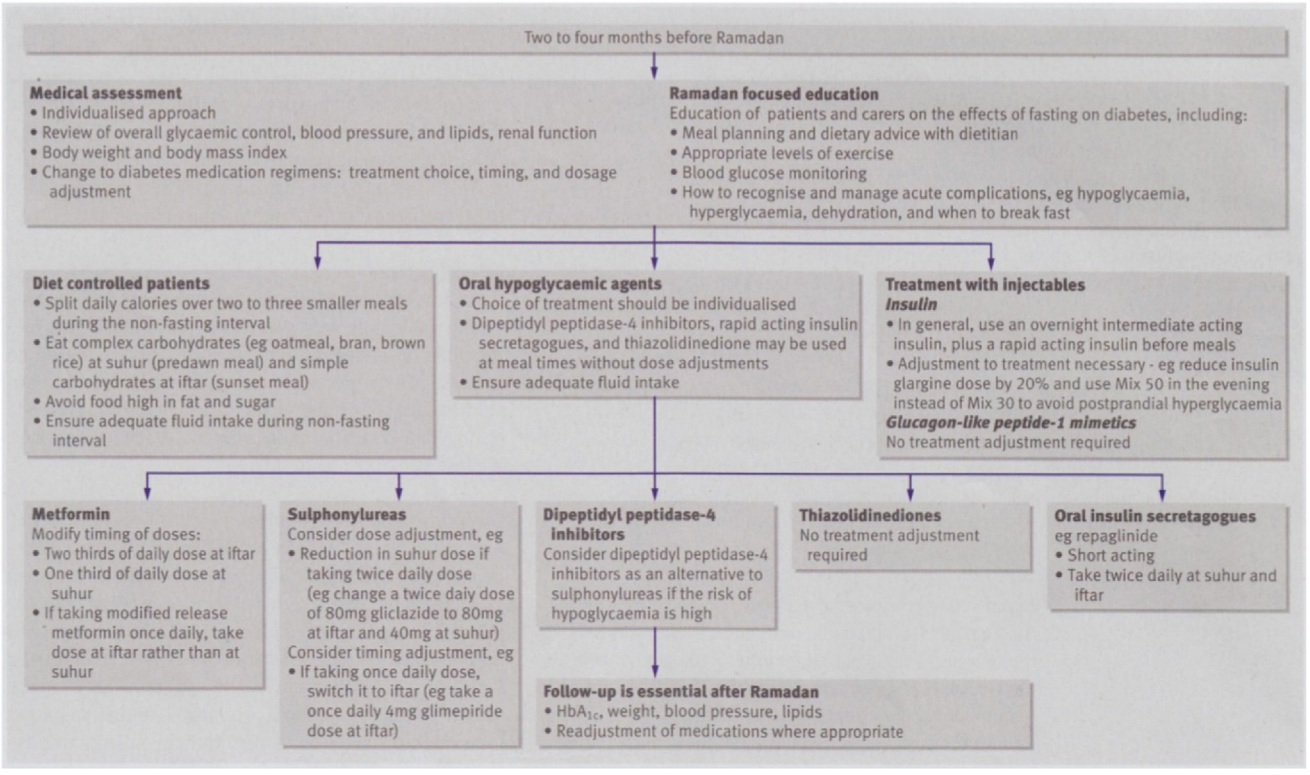

Fig. 2. Diabetic management algorithm during Ramadan. (Reprinted with permission from Hui et al. [14].)

the fast. The authors also found that 76.49% of the total daily energy intake was eaten during *Iftar*, whereas the morning meal (*Sahour*) represented only 14.13% of energy intake secondary to most patients skipping it. This study showed a lower fasting glucose level and higher low-density lipoprotein (LDL) level with return to baseline after conclusion of the fasting period. Three noncomplicated episodes of hypoglycemia were recorded. Similar findings were reported by Vasan et al. [19], who studied 70 patients with T2D who received dietary counseling. After Ramadan, no significant difference in body weight or BMI was found. Diabetic control was found to be optimal despite frequent self-reported dietary indiscretions. No hypoglycemic episodes were reported. Karatoprak et al. [20] matched 76 fasting to 71 nonfasting patients with T2D and compared fasted and postprandial blood glucose, weight, and HbA1C before and after the fast. Patients on oral antidiabetic drugs and parenteral insulin were included in this study, and despite this, no statistically significant difference in values was found. Two noncomplicated hypoglycemic episodes were reported, 1 in the fasting and 1 in the nonfasting group. Three severe hyperglycemic episodes in the fasting group and 1 in the nonfasting group also were mentioned.

In summary, all the available studies mentioned concluded that with adequate supervision and education, select, well-controlled patients with diabetes can fast and do so safely and may even reap the metabolic benefits of fasting.

Fasting and cardiovascular function

Review of the literature on fasting and cardiovascular effects showed a wide variety of geographic locations, inclusion populations, cardiovascular profiles, and co-morbid conditions and fasting religions, including the Ramadan fast, the Greek Orthodox fast, and the Daniel fast. Cardiovascular parameters studied were not uniform, making it challenging to make overarching conclusions. The studies included a combination of the following parameters before and after fasting: lipid profile (i.e., total cholesterol, triglyceride, high-density lipoprotein cholesterol [HDL-C], and low-density lipoprotein cholesterol [LDL-C]) [4,21–25], lipoproteins [24], blood pressure [23,26–28], complete blood cell count including hemoglobin and hematocrit [21,28,29], resting heart rate [4,30], pulse wave velocity [30], arterial stiffness [30], homocysteine [28], and C-reactive protein [28]. Anthropometrics also were compared in most of the studies and included weight, BMI, waist circumference, WHR [4,24,25,28]. Few studies included body composition, and few studies identified eating habits, food choices, and macronutrient breakdown or other lifestyle practices such as physical activity or sleep pattern

[4,21,24,25,28]. Few articles included insulin and homeostasis model assessment for insulin resistance (HOMA-R) results [4,21,28].

Results of the studies were contradicting and most likely related to the variability of research methodology, population, geographic region, season and duration of fasting, nature of the diet, and number of calories consumed during Ramadan. The meta-analysis by Kul et al. [22] was performed on self-controlled cohort studies from 1950 to 2012 and included studies only on healthy participants with normal body weight following Ramadan. Results of this meta-analysis found a statistically significant reduction in total cholesterol and triglycerides in males and a significant reduction in LDL in both males and females. The meta-analysis showed, however, that HDL levels increased significantly in women only. This was contradictory to the results of Rahman et al. [25], who found that HDL increased during Ramadan fasting in a population study of healthy males. Shebab et al. [23], Lamri-Senhadji et al. [24], and Nematy et al. [28] found increased HDL in both men and women. Bethancourt et al. [21] also found an increase in HDL when participants followed a milk, dairy, and egg fast, although not significant. In addition, the milk, dairy, and egg fast did not show significant associations between body fat, glucose, insulin, or CRP. Interestingly, the study by Bloomer et al. [4] showed a decrease in HDL when following the 21-day Daniel fast.

The systematic review by Mazidi et al. [26] assessed the effects of Ramadan fasting on cardiovascular outcomes and risk factors. The researchers found an inconsistency of results based on the limitations of the studies. The literature from 1982 to 2014 was reviewed, and the authors found that the incidence of acute cardiac illness during Ramadan fasting was similar to that during nonfasting days and that there was no significant difference in the number of hospitalizations for heart failure during Ramadan versus the rest of the year. The authors also found that Ramadan fasting was associated with elevations in HDL-C and reductions in LDL-C and total cholesterol, therefore improving cardiovascular risk factors. However, the review showed that those who had concomitant diabetes showed unfavorable changes in lipid profile. The authors concluded that Ramadan fasting is not associated with any significant adverse incidence of cardiovascular illness in those with history of cardiovascular disease except for those who also have diabetes, for whom Ramadan fasting may have an adverse effect on the lipid profile.

When looking at the relationship between fasting and blood pressure, most studies found a significant decrease in blood pressure during Ramadan fasting [4,23,25,27,29]. However, Sezen et al. [30] did not find a significant change in blood pressure or resting heart rate in a study examining Ramadan fasting in Turkey in a population of men with overweight and obesity.

For the studies that looked at dietary intake and composition, most showed a decrease in energy intake during fasting (for Ramadan and Daniel fasts) [4,28]. However, Lamri-Senhadji et al. [24] found an increase in energy intake during Ramadan. Rahman et al. [25] found no significant differences in carbohydrate and protein intake, and fat intake was significantly higher during Ramadan, most likely caused by an intake of fried foods during *Iftar* from this geographic region (Bangladesh).

In summary, the reviewed studies showed that fasting for Ramadan, the Daniel fast, or the Orthodox Christian fast does not appear to have an adverse effect on healthy individuals, those who have overweight or obesity, or those with comorbid conditions or a history of cardiovascular disease. Fasting for Ramadan does not increase the risk of hospitalizations in those with a history of cardiovascular disease. In addition, cardiometabolic risk factors such as blood pressure and lipid profiles may improve during and after fasting, with attention given to populations with concomitant diabetes, where lipid profiles may change unfavorably. Energy intake and dietary composition may change during fasting, but this may have no significant effect on the cardiovascular benefits of fasting. It should be noted that the studies reviewed here had a wide variation in geographic region examined, fasting duration times, ambient temperatures, inclusion criteria, and population size.

Fasting and human metabolism

In studies that specifically examined fasting during Ramadan, there was also a notable heterogeneity in geographic locations, population inclusion criteria, and metabolic parameters examined. Metabolic parameters reported included a combination of the following pre- and postfasting measures: lipid profile (i.e., total cholesterol, triglyceride, HDL-C, and LDL-C), lipoproteins [31–35], HbA1C, neuropeptleptin [33,36], insulin [31,34,36,37], blood pressure [38], complete blood cell count, respiratory rate, and CRP [37]. Anthropometrics also were compared in most of the studies and included weight, BMI, waist circumference, WHR, fat mass, and protein body mass [34,38–42], and some studies identified nutrient intake [31,33,36,37,39,41,43], physical activity [39,42], and educational status [32,42].

Fasting triggers complex neural, metabolic, hormonal, and behavioral adaptations with the goal of maintaining the energy substrates for use by the brain, protecting lean mass, and promoting survival [36]. During Ramadan, Muslims have 2 main meals, 1 before dawn and the other after sunset. Similar to calorie-restricting diets, skipping a meal during Ramadan theoretically can lead to weight loss. However, dietary changes during Ramadan vary with a common overcompensation of dietary intake and dominance of carbohydrate in the morning (*Suhour*) and lipid in the evening (*Iftar*) depending on region [44]. The observance of

Ramadan fasting also changes sleeping and activity patterns, which results in subsequent alteration in circadian rhythm, cortisol, insulin, leptin, ghrelin, growth hormone, prolactin, sex hormones, and adiponectin [37,44,45].

Many studies have assessed the effects of Ramadan fasting on different metabolic and anthropometric parameters but have noted conflicting results [34]. These studies need to be interpreted carefully and with consideration for several confounding variables, such as age, sex, ethnicity, hours of fasting, timing of previous meal, climatic conditions, cultural influences, physical activity, and, most commonly, the dietary patterns, sleeping hours, and methodologic differences [40]. Duration of fasting is one of the most relevant factors depending on the geographic location [44]. Combination of these parameters also can produce different metabolic effects, and Ramadan fasting studies have reported various and conflicting metabolic effects [35,40].

Studies on the effect of Ramadan on energy metabolism and body composition have not reached consensus [37]. Most studies, including a meta-analysis, have reported a decrease in body mass, but not all. Reports on changes in blood metabolic profile are also inconsistent and contingent on the quantity and quality of the diet and on body composition. There are some discrepancies among studies regarding the clinical benefits of intermittent fasting. As discussed previously, this is particularly so for individuals with chronic conditions such as diabetes, who need specialist advice as to whether Ramadan fasting is suitable in the first place. Pre-Ramadan planning (e.g., nutrition plans, medication plans, and health checks) is necessary in patients with diabetes because prolonged Ramadan fasting periods can lead to severe hypoglycemia or ketoacidosis [45].

It should be noted that the effects of Ramadan fasting are not limited to neutral or positive benefits. Disturbances attributed to Ramadan fasting have been noted and include decreased sleep quality and gastrointestinal complications, including thirst, hunger, bloating, heaviness, abdominal fullness, constipation, and heartburn, weakness, and headache [44–46]. Healthcare providers should be aware of these potential conditions as they give guidance and education to their patients who desire to fast.

Fasting and other effects on human health

Eating disorders

When looking further at religious fasting, Angelova et al. [47] explored the link to fasting and eating disorders in Bulgarian women using the Eating and Activity Over Time (EAT) survey. Religious fasting did not appear to increase eating disorders, but women who scored higher on an eating disorder survey appeared to have a negative body image and viewed the fasting as improving their body image [47]. Savas et al. [48] did not find a change in eating disorder scores before, during, and after Ramadan.

Sleep and sleep pattern

The effect of fasting on sleep has been studied, and it appears that fasting does affect sleep and sleep pattern. Lessen et al. [49] found that sleep time was significantly altered during Ramadan. Another study showed that religious fasting caused changes in drowsiness, sleep patterns, and psychomotor delays during the fasting period [50].

Weight and body composition

Numerous studies have addressed physiologic, weight, and anthropometric consequences of fasting during and after fasting for Ramadan with varying results. In a meta-analysis addressing weight loss, most studies demonstrated a transient, insignificant weight loss with a return to baseline weight by 2–4 weeks after Ramadan concluded [51,52]. Weight gain or loss during fasting appears to be related to food quality and composition. In a cross-sectional analysis of Saudi families, a study by Hajek et al. [53] demonstrated a weight gain in patients who consumed higher amounts foods rich in fats and carbohydrates along with a decrease in physical activity during Ramadan. Meanwhile, in a study by Suriani et al. [54], diet changes made during the fasting period from a group of Malaysian women included incorporating more protein, milk, and dairy and fewer carbohydrates, vegetables, and fruit. This change in diet led to a significant decrease in BMI and weight, along with HDL, LDL, and triglyceride [54]. Some research also showed that those with a normal body weight who fasted did not lose weight during the fasting period, but other metabolic markers such as glucose and lipid profiles changed favorably [55]. Other studies showed that positive changes in body composition and weight loss were correlated with a higher BMI. Fernando et al. [56], Lopez-Bueno et al. [57], and Rohin et al. [58] showed a change in body weight and waist circumference, which was shown to be greatest in those with obesity/overweight but no significant change in body fat percentage.

Resting metabolic rate and activity

Activity and energy expenditure with fasting also were investigated. A study by Lessan et al. [49] examined resting metabolic rate (RMR) before, during, and 2 months after the break of the Ramadan fast in healthy participants without obesity. The researchers found no significant change in RMR in the pre- and post-Ramadan timing, but RMR showed a decrease each week as the fasting month progressed, even though the thermic effect of food was not significantly altered, and physical activity appeared highest in the evening. In another study on sedentary Kuwaiti males, changes in body composition and exercise during the month of Ramadan were assessed [59]. Although the results showed a higher maximal heart rate most likely secondary to dehydration, body weight and body fat percentage did not change significantly, nor did aerobic fitness levels. Laboratory values, such as hemoglobin and hematocrit, were stable over the month of fasting [59].

Table 1
Risk stratification for fasting after bariatric surgery

High-risk fasting not recommended	Low-risk fasting possible with guidance
Pregnancy	Weight loss plateau or stable weight
Chronic dialysis	Met goal weight and maintaining weight
Acute illness	No active medical issues
Elderly with active disease	Not using insulin
Severe hypoglycemia	No current hypoglycemia
History of recurrent hypoglycemia	No current food or hydration issues
No social support	No current micronutrient deficiencies
Living alone	Compliant with bariatric diet, including vitamin and mineral supplementation as needed
Those who have been lost to follow-up	Well-controlled (or no) diabetes
Poor food tolerance	No alcohol dependency
Poor adherence to bariatric diet (i.e., inadequate protein, fluid, or vitamin supplement intake)	No active recreational drug or tobacco use
History of dehydration in the past 3 months	Attends follow-up visits
Within the active rapid weight loss period*	
Presence of untreated micronutrient deficiencies	
Presence of untreated protein-calorie malnutrition	
Insulin-dependent type 1 or type 2 diabetes	
Uncontrolled type 2 diabetes	
Type 2 diabetes with complications	
Type 2 diabetes with unstable disease	
Active abdominal pain or presence of obstruction	
Presence of eating disorders or maladaptive eating issues	

* The active weight loss period is defined as the first 12 months for metabolic surgeries that provide restriction but not malabsorption, such as sleeve gastrectomy and adjustable gastric band, and the first 18 months for metabolic surgeries that cause restriction and malabsorption, such as Roux-en-Y gastric bypass and biliopancreatic diversion duodenal switch [66].

Adiposity and metabolic markers

When evaluating adiposity and metabolic markers, results have also varied in fasting participants during Ramadan. Some studies showed a decrease in weight, BMI, and serum lipids [58,60–63]. Two cross-sectional studies showed no change in visceral adiposity before and after Ramadan [60,63]. However, Faris et al. [61] demonstrated a decrease in visceral adiposity using magnetic resonance weighted images. The researchers showed significant changes in apelin, leptin, visfatin, insulin-like growth factor 1, and adiponectin with fasting. A decrease in tumor necrosis factor α with an increase in adiponectin was demonstrated with Ramadan fasting [62]. Faris et al. [64] found that proinflammatory markers decreased with fasting but returned to baseline after cessation of fasting.

Aside from metabolic parameters, 1 study examined how gastrointestinal (GI) issues/symptoms change with fasting [65]. A cross-sectional study using validated questionnaires to evaluate GI symptoms after fasting was given to 900 healthy adults in Iran. Mean age was 36.4 years, 85.8% were married, and 87.2% fasted for at least 14 days. Those fasting fewer days were predominantly female and had more severe GI complaints. The authors compared frequency of GI symptoms with fasting duration. There was no change in frequency of GI symptoms with fasting, except constipation [65].

In summary, available studies on religious fasting have demonstrated varied results on weight, body composition, adiposity, sleep patterns, food choices, RMR, metabolic markers, and gastrointestinal symptoms.

Summary and Recommendations

According to the results of this review, research indicates that fasting in the nonbariatric population appears to be safe and can be encouraged even in the presence of certain co-morbid conditions, except uncontrolled diabetes. In addition, practitioners should be aware that potential sleep and GI disturbances may be associated with fasting. However, considering the scarcity of research on the effects of fasting as it relates specifically to issues surrounding the aftermath of bariatric and metabolic surgery, and in order to encourage safe patient practices, this article stratifies patients with bariatric and metabolic surgery who desire to fast into either a high-risk or low-risk category. This stratification can be used by practitioners to guide the decision-making and education of these patients.

The high-risk and low-risk classifications (Table 1) were adapted from the management of people with diabetes wanting to fast [14], and in addition, through expert consensus, additional criteria that are deemed more relevant to metabolic and bariatric surgery were added. *High risk* is defined as patients having medical reasons or conditions where fasting may be harmful or increase adverse consequences, and *fasting is not recommended*. *Low risk* is defined as patients who pose less of a health risk and may

consider fasting with appropriate guidance and education; here *fasting is possible with guidance*.

General and Nutrition Guidelines for Fasting After Bariatric Surgery

This section provides additional suggestions specifically for the guidance of patients with metabolic and bariatric surgery who desire to fast. For specific nutrition guidelines, it is encouraged that readers reference the "American Society for Metabolic and Bariatric Surgery integrated health nutritional guidelines for the surgical weight loss patient 2016 update: micronutrients" [67], and the "Clinical practice guidelines for the perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric procedures 2019 update—cosponsored by American Association of Clinical Endocrinologists/American College of Endocrinology, The Obesity Society, American Society for Metabolic and Bariatric Surgery, Obesity Medicine Association, and American Society of Anesthesiologist" [68].

1. It is recommended that patients who underwent bariatric surgery follow up with their surgeon and interdisciplinary bariatric team *prior to* fasting for assessment and guidance with safe fasting practices after bariatric surgery.
2. Patients with diabetes are encouraged to consult with their healthcare clinicians to make appropriate medication adjustments of oral hypoglycemic agents and/or insulin.
3. All patients who want to fast should be prescribed a proton pump inhibitor to be taken daily for the duration of the fasting period. Fasting patients during Ramadan have been reported to complain of new-onset or exacerbation of existing GI complaints, among the most common being dyspepsia and heartburn [69]. Additionally, patients with diabetes have been found to have higher rates of reflux esophagitis [70]. Ramadan fasting has been found to modify the circadian rhythm, leading to an increase in gastric acidity during the daytime [71]. The number of duodenal ulcers and duodenitis during Ramadan has been shown to be higher on upper endoscopy [72,73]. Proton pump inhibitors have been used empirically on fasting patients because such patients have reported good control of their symptoms with these medications [69].
4. Drink adequate fluids, preferably water, and maintain adequate hydration of >1.5 L/d.
   a. When breaking the fast or preparing before the fast, eat hydrating foods such as vegetables, salads, fresh fruit, clear broths, and soups.
   b. Consider sugar-free, electrolyte-containing beverages if fasting days are during high temperatures or high humidity, which may cause increased perspiration and increased risk of dehydration.
   c. Avoid alcohol, caffeine, carbonation, and sugary beverages. Despite the lack of empirical research supporting the avoidance of carbonation after bariatric surgery, it was the consensus of these authors to continue the recommendation to avoid carbonation. There is some evidence presented in the nonbariatric literature that carbonation or ingredients found in carbonated beverages may have a detrimental effect on bone health, GI health, and oral health [74–76]. A patient-centered approach to dietary guidance is highly supported.
   d. Avoid excessively salty or spicy foods because they may contribute to dehydration.
5. Limit intake of sweets (<10% of daily calories per day) to avoid dumping syndrome, consumption of empty calories, and increased risk of dehydration.
6. Pre- or postfasting meals should be nutritionally balanced and incorporate whole grains, lean proteins, and unsaturated fats. Recommended protein intake is 60–120 g/d, or individual assessment may consider increased protein intake especially for patients with more malabsorptive bariatric procedures or if actively losing weight. Protein intake may be assessed with a range of 0.8–2.0 g/kg body weight per day [68].
7. Avoid excessively fatty foods such as those which are fried, processed, or contain high amounts of saturated fats.
8. At the postfasting meals, rather than having one large meal, consider smaller, more frequent eating times to increase nutritional protein intake while avoiding overfilling the pouch.
9. Choose leaner cooking methods such as grilling, poaching, baking, sautéing, and stewing rather than deep frying.
10. Take the recommended dosages of vitamin and mineral supplements as prescribed by your practitioner.

Conclusion

The American Society for Metabolic and Bariatric Surgery will continue to monitor and evaluate emerging data on fasting after metabolic and bariatric surgery and, when appropriate, will issue an updated review statement at a future time.

Disclosures

L. Craggs-Dino is a member of the advisory board of Bariatric Fusion LLC and has received honoraria from Medtronic, Cine-Med, and Catalyst Training Lab for educational presentations. M. El Chaar has received speaking and consulting honoraria from Intuitive, Gore, and Boehringer. A.M. Rogers has received speaking honoraria from Ethicon, Gore, Medtronic, and Intuitive. The

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