INTRODUCTION

Physiological changes during fasting in Ramadan

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Abstract

Fasting during Ramadan is one of the five fundamental pillars of Islam and mandatory for all healthy adult Muslims to fast from sunrise to sunset for a period of a month. During fasting, Muslims are required to refrain from all intakes of food, water, beverages, smoking and from sexual intercourse. Ramadan fasting causes many physiological, biochemical, metabolic and spiritual changes in the body. Ramadan Fasting increases the Red Blood Cells (RBCs), White Blood Cells (WBCs), platelet (PLT) count, High Density Lipoprotein Cholesterol (HDL-c), and decreases the blood cholesterol, triglycerides, Low Density Lipoprotein Cholesterol (LDL-c) and Very Low Density Lipoprotein Cholesterol (VLDL-c). Moreover, it reduces body weight, waist circumference, body mass index, body fat, blood glucose, systolic and diastolic blood pressure and anxiety levels. Furthermore, Ramadan fasting decreases the inflammation, pro-inflammatory cytokines IL-1β, IL-6, tumour necrosis factor α and cancer promotion. Among healthy adults, there are no adverse effects of Ramadan fasting on the brain, heart, lung, liver, kidney, haematologic, endocrine profile and cognitive functions. Ramadan fasting is a healthy non pharmacological means for minimizing the risk factors and improving health. Although Ramadan fasting is safe for all healthy individuals, but those with various illnesses such as diabetes mellitus, coronary artery disease, renal and eye illness should consult their physicians and firmly follow the scientific recommendations.

Keywords: Fasting, Ramadan, Physiological Changes.

Introduction

Fasting during the month of Ramadan is one of the five fundamental pillars of Islamic practices, mandatory for all healthy adult Muslims. In Ramadan, Muslim adults fast from sunrise to sunset and are required to refrain from oral intake of food, water, beverages, smoking and sexual intercourse. This type of fasting is defined as periodic food and water deprivation during day light hours with free access during the night for the duration of one month.[1] Muslim world covers a vast geographic area, comprising of 57 countries with 2.02 billion people.[1] Globally, over one billion Muslims fast during the month of Ramadan.[3]

Fasting hours during Ramadan: Ramadan is a lunar calendar based month, its duration varies between 29 and 30 days, the fasting month is brought forward by about 10 days in a year in Gregorian calendar, it means over time the season in which Ramadan falls changes. Depending on the geographical settings and season, the duration of the daily fast may range from 12 to 20 hours. During Ramadan, the body physiology changes occur from normal to fasting routines and then vice versa.

Diet regime and changes in daily activity: During the Ramadan fasting, there is a change in number, timing, composition and calorie content of meals. Normally, people take three main meals and some snacks daily. During Ramadan the number reduces to two, one large meal at sunset and one light meal before dawn. There are also changes in the timings of meals. This is mainly due to fasting during the daytime. The distribution of non-Ramadan meals changes to dinner at sunset (Fatour) and breakfast (Suhur) before sunrise. Along with changes in number, timing and calorie content of the meals the composition of the meal is changed as well. During Ramadan, there is more consumption of carbohydrates in the form of dates, juices and especially fruits. Changes in the timings and composition of food have a direct effect on the calorie intake. There is generally reduced calorie intake during the first week of Ramadan, but from then onward there is a progressive increase. It has been noted that total energy intake remained unchanged whereas qualitative components of nutrients are markedly affected.[4] In addition to the food habits, the physical activity generally reduces during the daytime because of fasting and increases during the night time especially for people who perform Taraweeh (prayer).

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Consumption of energy: Fasting person consumes on an average of 1220 Kcal/day during Ramadan and lose a significant body weight of about 2.0kg.[5] Males and females experienced a decrease in body mass index with reduction in food, water, energy intake during fasting however, females tend to lose more weight than males.[6]

Physiological Changes: Ramadan fasting causes many physiological, biochemical, metabolic, and spiritual changes in the body. Physiological changes during Ramadan are not very well known and reports in the literature concerning the effects of Ramadan are very few. In the present review, we have highlighted the various haematological, bio chemical and physiological changes on the different systems of the human body.

Body water and Electrolytes: Water and electrolytes are essential for life. In humans, an exquisitely sensitive network of physiological control is involved to maintain body water and fluid intake. The mechanism of thirst is quite clear and the reason for non-regulatory drinking is often encountered, related to the capacity of renal physiology in association to anti-diuretic hormone (ADH) to rapidly eliminate excesses of water or reduce urine secretion to temporarily economize on water.[7] During Ramadan fasting, over the morning and afternoon, urine volume, sodium, potassium and total solute excretion were lower, and urinary osmolality was higher. The osmolality of the urine samples, collected in the afternoon was very high, indicating effective water conservation[8] both by maximum urinary concentration and a decreased obligatory urine output.

Trabelsi et al.,[9] determined the effect of Ramadan fasting on body water status. They found that the total body water before Ramadan did not differ significantly from after one month Ramadan Fasting. However, during Ramadan the signs of dehydration have been identified by increased measures of haematocrit, haemoglobin and plasma osmolarity. This state of dehydration has been attributed to the reduction of fluid intake.[10] Azwany et al.,[11] examined the effects of one month Ramadan fasting, they reported a significant increase in urinary osmolarity after four weeks of fasting. Azizi and Rasouli[12] mentioned that fasting in Ramadan does not bring about a considerable change in serum sodium and potassium. However, Morilla et al.,[13] found that potassium was reduced mainly in the mornings and its amount increases in the afternoons. In another study, Hosseini et al.,[14] demonstrated that, the mineral and total water showed no difference in both groups who fast and exercise and subjects who fast without exercise.

Blood cell count and haemoglobin percentage: During the month of Ramadan, the haematological parameters show slight variations specially the Red Blood Cells (RBC) count and haemoglobin (Hb %). The RBCs count and Hb percentage decrease initially but return back to normal after the end of Ramadan fasting month. Seyyed et al.,[15] reported a significant reduction of RBCs count, while Hb percentage and haematocrit (Hct) values decreased significantly after Ramadan compared to before Ramadan. Although no significant changes were found in WBCs and platelets.[15] Sarraf-Zadegan et al. and Argani et al.,[16,17] showed no changes in WBC count or any other haematological parameters throughout Ramadan; Bouhlel et al.,[18] Showed a significant increase in Hb and Hct. Moreover, Nematy et al.,[19] reported a significant increase in WBC, RBC and platelet (PLT) counts after fasting in Ramadan.

Bio-chemical changes (Lipid profile): There is a controversy in existing literature about the lipid profile during Ramadan fasting. Adlouni et al.,[20] reported that fasting during Ramadan led to a significant decrease in serum total cholesterol, triglyceride and LDL-C, while a significant increase in the serum HDL-cholesterol during the fasting month. On the other hand, Maislos et al.,[21] noted that LDL-C, very-low-density lipoprotein (VLDL) and total-cholesterol have not changed, while the authors found a significant increase in HDL-cholesterol levels and a reduction in the LDL/HDL and TC/LDL ratio at the end of Ramadan.

Kul et al.,[22] conducted a meta-analysis comparing body weight, blood levels of lipids and fasting blood glucose before and after Ramadan. The primary findings of their study was that, after Ramadan fasting, low-density lipoprotein and fasting blood glucose levels were decreased in both genders compared to levels prior to Ramadan. In addition, in the female subgroup, body weight, total cholesterol and triglyceride levels remained unchanged, while HDL level was increased. In male subjects, Ramadan fasting resulted in weight loss, reduction in total cholesterol and LDL levels and a small decrease in triglyceride levels. They also concluded that Ramadan fasting can effectively change the body weight and some biochemical parameters in healthy subjects especially in males compared to pre-Ramadan period.

Nematy et al.,[19] reported a significant increase in HDL-c, and decrease in plasma cholesterol, triglycerides, LDL-c, VLDL-c, body mass index and waist circumference after fasting in Ramadan. Shehab et al.,[23] determined the effect of fasting during Ramadan on plasma lipid and lipoprotein variables among healthy normal individuals. The authors found significant and beneficial changes in

Table-1: Ramadan Fasting and Human Health.

Parameters	Effect of Ramadan Fasting
Haematological changes	No significant change in WBC.[16,17] Increase Haemoglobin (Hb%). Haematocrit values, RBCs, WBCS and Platelet counts.[18,19]
Lipid Profile	Decrease serum total cholesterol, triglyceride, LDL-c, VLDL-c, and significant increase in HDL-cholesterol.[19,21,23]
Hormones	No change in Luteinizing hormone (LH), follicle stimulating hormone (FSH), estradiol (E2), testosterone, and prolactin (PRL). Decrease blood glucose level.[28]
Body weight and fat	Decrease body mass index, body fat, and waist circumference.[5,6,23,31,30]
Cardiovascular system	Decrease systolic and diastolic blood pressure. Incidence of acute coronary artery syndrome, atrial fibrillation, acute decompensated heart failure and cerebral stroke is similar during the month of Ramadan as compared to the other non-fasting months.[36]
Respiratory System	FVC was decreased, forced expiratory flow rates at 75%-85% of the Vital capacity significant increase. FEV1% increased both during fasting and after Ramadan. Vital capacity and Peak expiratory flow rate was significantly increased during Ramadan.[40-42]
Ocular system (Eye)	Tear proteins, lysozyme, lactoferrin and alpha amylase enzymic activity decreased during Ramadan fasting.[43] Intraocular pressure (IOP) increased.[44] Anterior chamber depth and Intraocular lens power was significantly increased during fasting and returned to baseline one month after Ramadan. However, no significant differences in spherical equivalent and corneal astigmatism.[46]
Inflammatory markers	Decrease inflammation, pro-inflammatory cytokines IL-1β, IL-6, tumour necrosis factor α, cancer promotion.[48]

Triglycerides (TG), HDL-C and LDL-C, at the end of Ramadan. Furthermore, there was a progressive and significant increase in HDL-C and decrease LDL-C, a month after Ramadan.

Qujeq et al.,[24] determined the status of low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C) in subjects during Ramadan fasting. Their results showed statistically significant reduction in the LDL-cholesterol concentrations in mid Ramadan and end of Ramadan compared to concentration levels before Ramadan. The results showed statistically significant elevation in the HDL-cholesterol concentrations in mid-Ramadan and end of Ramadan compared to levels before Ramadan. Their findings suggest the usefulness of Ramadan fasting in the restriction of fat intake which is associated with lowering of serum cholesterol.

Serum Uric Acid: Ramadan fasting did not dramatically affect the carbohydrates, proteins and lipid metabolism, or the everyday mean of hormonal serum levels. An increase in urea and uric acid was frequently reported and this could be attributed to dehydration during this month.[17] In another study, it has also been reported that, in fasting subjects the serum uric acid is increased significantly.[25] This is due to reduced glomerular filtration rate and consequently decreased uric acid clearance. In patients with elevated levels of uric acid this may be of concern but in normal subjects it is not significant. Due to reduced fluid intake, change in fluid and electrolyte there is increase in total proteins, albumin, creatinine, urea, SGOT, SGPT, alkaline phosphatase, calcium and potassium.[26] However, the values reach the baseline as soon as Ramadan is over. Most of the physiological changes are transitory and may not be significant in normal subjects but can have ill effects in patients who suffer from hypertension, hyperlipidaemia, hyperuricaemia, cardiac problems and diabetes mellitus. Therefore, these patients require close supervision and careful monitoring before and during fasting.

There are no adverse effects of Ramadan fasting on the nervous, cardiovascular, respiratory systems, liver, eyes, haematologic, endocrine profile and neuro-psychiatric functions. However, due to reduced fluid intake, dehydration, there is increase in electrolytes and urea concentration,[8] but, the values reach the baseline as soon as Ramadan is over. Although Ramadan fasting is safe for all healthy individuals, but, those with various diseases must consult their family physicians and follow scientific recommendations.[27]

Hormonal changes during Ramadan Fasting: Caglayan[28] conducted a study and determined on Luteinizing hormone (LH), follicle stimulating hormone (FSH), estradiol (E2), testosterone, and prolactin (PRL). Their results shows that before and during fasting Luteinizing hormone, follicle stimulating hormone, estradiol, testosterone and prolactin levels were not statistically different. Effect of Ramadan fasting on hormone levels was found to be within the normal limits.

Another essential hormone is Insulin, the secretion of which in healthy individuals is stimulated with feeding and which promotes the storage of glucose in liver and muscles as glycogen. In contradictory, during fasting circulating glucose levels tend to fall, leading to decreased secretion of insulin. At the same time, levels of glucagon hormone and catecholamines rise, enhance the breakdown of glycogen, while gluconeogenesis is augmented.[21] As fasting becomes extended for more

than several hours, glycogen stores become used up, and low levels of circulating insulin allow increased fatty acid release from adipocytes. Oxidation of fatty acids generates ketones that can be used as fuel by skeletal and cardiac muscle, liver, kidney, and adipose tissues, thus sparing glucose for continued utilization by brain and erythrocytes.

In normal individuals, the process described above is regulated by a delicate balance between circulating levels of insulin and counter regulatory hormones that help maintain glucose concentrations in the physiological range. In patients with diabetes, however, insulin secretion is disturbed by the underlying pathophysiology and often by pharmacological agents designed to enhance or supplement insulin secretion.[29] In patients with severe insulin deficiency, a prolonged fast in the absence of adequate insulin can lead to excessive glycogen breakdown and increased gluconeogenesis and ketogenesis, leading to hyperglycaemia and ketoacidosis.[21] Therefore, diabetic patients should consult their physician a month before the Ramadan fasting.

Body weight and waist circumference: It has been shown in previous studies by Shaheena and Kauser[30] that Ramadan fasting reduces waist circumference, basal metabolic index and overall body weight. Norouzy et al.,[31] assessed the effects of Ramadan intermittent fasting on body weight and composition. They found that Ramadan fasting leads to weight loss and fat-free mass reductions and the body composition changes were variable depending on age and gender. Shehab et al.,[23] determined the effect of fasting during Ramadan on body weight among healthy normal individuals. They found significant and beneficial changes in body weight, waist circumference (WC) at the end of Ramadan. Trabelsi et al.,[9] assessed the effects of Ramadan fasting on body fat in physically active men during, and after Ramadan. They found that body weight and body fat percentage decreased in fasting people. They also concluded that Ramadan fasting lowers body weight and body fat percentage and can elevate high-density lipoprotein cholesterol in physically active men. In addition, Bouhlel et al.,[32] evaluated the effect of Ramadan fasting on body fat and found that Ramadan fasting was associated with a reduction of body mass and body fat percentage.

Cardiovascular System: Fasting during Ramadan is a radical change in lifestyle for the period of a lunar month, and life style change has a significant impact on cardiovascular system. Cansel et al.,[33] determined the effect of Ramadan fasting on heart rate variability in healthy individuals. They found that heart rate parameters were found to be increased in Ramadan month, and they also reported that Ramadan fasting enhances the parasympathetic activity.

Nematy et al.,[19] reported a significant improvement in 10 years coronary heart disease risk factors based on Framingham risk score after Ramadan fasting. There was a significant higher HDL-c and lower plasma cholesterol, triglycerides, LDL-c, VLDL-c, systolic blood pressure, body mass index and waist circumference after Ramadan. All these factors play an important role in minimizing the coronary artery disease. Some changes, such as the increase of HDL-c and apoprotein A1, and the decrease in LDL-c, could be beneficial for the cardiovascular system. Ramadan Fasting decreases the incidence of coronary artery disease by decreasing the cholesterol and triglycerides. Mossa et al.,[34] determined the effect of RF on lipid profile. They reported that there was a slight decrease in body weight, blood glucose. However, the effect of RF was non-significant. Although they found a significant decrease in serum cholesterol, serum triglycerides, LDL- cholesterol and a significant increase in serum HDL-cholesterol was observed at the end of Ramadan. HDL-cholesterol removes excess cholesterol from body cells and transport it to liver by preventing accumulation of cholesterol in blood. It is a well established fact that, decrease in LDL and increase in HDL is associated with a decreased risk of coronary heart disease. For this reason, Ramadan fasting is a good practice for the protection of cardiovascular system. Ramadan fasting reduces weight, waist circumference and BMI and thus, has beneficial effects on the body especially for obese people. It also reduces the anxiety levels in people. Ramadan fasting is a healthy non pharmacological means for improving cardiovascular risk factors.

Temizhan et al.[35] investigated the effects of Ramadan fasting on coronary heart disease patients. During the study period, the number of cases with acute coronary heart disease events was significantly lower in Ramadan than before or after Ramadan. They concluded that Ramadan fasting does not increase acute coronary heart disease events.

Shehab et al.,[23] determined the effect of fasting during Ramadan on blood pressure (BP) among healthy normal individuals. The author found significant and beneficial changes in systolic blood pressure at the end of Ramadan. The incidence of acute coronary artery syndrome, atrial fibrillation (AF), acute decompensated heart failure as well as stroke is similar during the month of Ramadan as compared to the other non-fasting months.[36] Some

studies have reported decrease in incidence of acute coronary syndrome and heart failure during Ramadan fasting.[36,37] A case control study has reported that the incidence of acute coronary syndrome decreased by 72% among Muslims who fasted regularly during Ramadan as compared to Muslims who did not fast.[38,39] Overall, the incidence of cerebrovascular accident (CVA) is similar during the month of Ramadan as compared to the other non-fasting days however a reduction in the incidence of haemorrhagic CVA is noted among hypertensive patients while an increase in incidence of ischaemic CVA is noted among diabetic patients. The mean systolic and diastolic blood pressure either remains unchanged or decreases during Ramadan fasting.[36]

Respiratory System: Siddiqui et al.,[40] assessed the impact of Ramadan fasting on lung function values. They found no significant change in the lung function parameters during Ramadan as compared to the pre-Ramadan period. However, FVC was decreased significantly in the post-Ramadan period compared to Ramadan. Relative to pre-Ramadan baseline values, there was no change in spirometric variables during Ramadan fasting.

In addition, Subhan et al.,[41] also determined the effect of Ramadan fasting on the expiratory flow rates in healthy subjects. There was a significant reduction in body mass in Ramadan compared to pre and post Ramadan. They found no significant changes in expiratory flows during Ramadan as compared to the pre Ramadan period. However, forced expiratory flow rates at 75%-85% of the vital capacity showed a significant increase in the post Ramadan period compared to Ramadan. Their findings show that Ramadan fasting did not affect expiratory flow rates in healthy subjects.

Moosavi et al.[42] evaluated the changes in pulmonary volumes during and after the Ramadan fasting period. They found that the mean FEV1% increased both during fasting and after Ramadan. Moreover, the mean vital capacity and peak expiratory flow rate was significantly increased during Ramadan. Although the mean maximum mid-expiratory flow decreased in the beginning of Ramadan but subsequently it was increased significantly, they concluded that fasting increases lung volume and improves the pulmonary function.

Ocular System (Eye): Human tear is an important biological fluid similar to blood in many aspects. Tear film is composed of basic layers of lipid, aqueous and mucin. The tear film covering the ocular surface, presents a mechanical and antimicrobial barrier, and endures an optical refractive surface. Sariri et al,[43] compared the tear protein content of sixty male and female volunteers one month before Ramadan and during fasting in the month of Ramadan. Their results showed that tear proteins decreased during fasting. On the other hand, the activity of enzymes such as lysozyme, lactoferrin and alpha amylase decreased. Kerimoglu et al.,[44] determined the effect of Ramadan fasting on intraocular pressure (IOP), basal tear secretion (BTS), reflex tear secretion (RTS), and corneal and anterior chamber parameters. Their results revealed significantly higher values for IOP, BTS, and RTS during fasting. Conversely at 1600 hours, IOP was significantly lower during fasting and no statistically significant difference was noted for RTS and BTS. IOP showed a diurnal variation of 2.45 mmHg, and BTS showed a 3.06 mm decrease during the fasting period. Their results showed that fluid loading at the pre-dawn meal during Ramadan fasting might increase the IOP, and tear secretion in the early morning period and these values decrease remarkably at the end of fasting due to dehydration. Assadi et al.,[45] reported that, Ramadan fasting does not profoundly affect the IOP, refractive error or visual acuity values in healthy volunteers. Moreover, Nowroozzadeh et al.,[46] looked for the effect of Ramadan fasting on ocular refractive and biometric properties. They found that the anterior chamber depth and Intraocular lens power significantly increased during fasting compared with baseline measurements and returned to baseline one month after Ramadan. However, the axial length significantly decreased during fasting and returned to baseline one month after Ramadan. There were no significant differences in spherical equivalent, corneal astigmatism, mean keratometry and flatter and steeper corneal radii of curvature between time intervals. Ramadan fasting is associated with significant alterations in anterior chamber depth and axial length that result in both statistically and clinically significant changes in intraocular lens power calculations. Therefore, relying on measurements taken during this month might lead to refractive errors especially after the cataract surgery. Javadi et al.,[47] conducted a study on the Ramadan fasting and physiological parameters which may influence the ocular system. They found that predawn water loading and dehydration in the evening are shown to increase and decrease Intra-ocular pressure (IOP) and tear secretion. Ocular blood flow was changed in Ramadan fasting, and suggests that patients with ocular vein occlusion may experience more frequent attacks.

Inflammatory markers and Cancer: It has been hypothesized that intermittent prolonged fasting practiced during the month of Ramadan positively affects the inflammatory conditions. Faris et al.,[48] conducted a cross-sectional study and reported that, intermittent

fasting decrease inflammation, cancer promotion and enhances life expectancy. The pro-inflammatory cytokines IL-1β, IL-6, and tumour necrosis factor α; systolic and diastolic blood pressures; body weight; and body fat percentage were significantly lower during Ramadan as compared with before Ramadan. These findings show that Ramadan fasting attenuates inflammatory status of the body by suppressing pro-inflammatory cytokine expression and decreasing body fat.

Ramadan Fasting and Diabetes Mellitus: Diabetes mellitus is a life-long disorder and is swiftly increasing in all age groups and both genders. It involves various physiological functions, organs and multiple systems.[49] The current figures have broken all the previous prevalence records as shown by the recent release of the International Diabetes Federation's 6th edition of the Diabetes Atlas,[50] which indicated that global prevalence of diabetes is 8.3% which means that 382 million adults are diabetics, and the number is expected to rise to 592 million by 2035. IDF also estimated that as many as 183 million people are unaware that they have diabetes.[50]

It has been reported that change in eating patterns during Ramadan fasting increased the risk of severe hypoglycaemia both in type 1 and type 2 diabetic patients. Severe hypoglycaemia is more frequent in patients when the dosage of oral antidiabetic drugs or insulin were not changed during fasting.[51] The authors also demonstrated increase in the incidence of severe hyperglycaemia during Ramadan in patients with type 2 diabetes and the occurrence of severe hyperglycaemia with or without ketoacidosis in type 1 diabetic patients.[51] Patients with diabetes, especially type 1 diabetes are at increased risk for development of diabetic ketoacidosis, particularly if they are grossly hyperglycaemic before Ramadan.[51] Moreover, limitation of fluid intake during the fast, especially if prolonged, is a cause of dehydration. This may become severe in hot and humid climates and among individuals who perform hard physical activities. Increased blood viscosity secondary to dehydration may enhance the risk of sinus venous thrombosis,[52] stroke and retinal vein occlusion.[53] There are gaps in the management of diabetic patients during Ramadan, diabetic patients need more attention. Diabetic patients who fast during Ramadan should be adequately investigated and must consult their family physicians one month before Ramadan fasting.[54]

Ramadan Fasting and hospitalizations: It has been reported by Bener et al.,[3] that there was no significant difference in the number of hospitalizations for stroke during Ramadan, when compared to the rest of the year. Moreover, their reports have shown that there was no significant difference in the number of hospitalizations for acute coronary syndromes and congestive heart failure while fasting during Ramadan when compared to the non-fasting months.[31] Fasting during Ramadan does not seem to increase hospitalizations for congestive heart failure. However, patients with decompensated heart failure or those requiring large doses of diuretics are strongly advised not to fast, particularly when Ramadan falls in summer. Patients with controlled hypertension can safely fast. However, patients with resistant hypertension should be advised not to fast until their blood pressure is reasonably controlled.

Ramadan Fasting and Sick patients: Most of the Muslims who suffer from chronic diseases insist on fasting in Ramadan despite their being exempted by religion. The holy book of Muslims, (Quran) specifically exempts the sick from fasting.[55] This exemption represents more than a simple permission not to fast; the Prophet Mohammad (PBUH) said, "God likes his permission to be fulfilled, as he likes his will to be executed." However majority of Muslim patients insist on fasting. Patients with unstable angina, recent myocardial infarction, cardiac intervention or cardiac surgery or any debilitating diseases should avoid fasting. Physician's advice should be mandatory and patients are encouraged to seek medical advice before fasting in order to adjust their medications, if required. Medical checkup one month before Ramadan is warranted, especially for those with chronic illnesses such as cardiovascular disease, diabetes mellitus and renal disease. Patients with heart failure, uncontrolled hypertension, arrhythmias, unstable angina, recent myocardial infarction, or cardiac surgery should be considered unfit for undertaking the Ramadan Fast as Holy Quran exempts the sick people from the obligation of fasting.[56]

Ramadan Focused Education: The education concerning fasting during the holy month of Ramadan is essential; and physicians and health educators must play a key role of a mentor. Physicians must inform the patient about the complications of fasting during Ramadan, and based on the clinical history, lab reports, and overall health status of patients, counsel the patient either to fast or not. The significance of education of patients is vital and is the cornerstone of safe fasting. Physician must guide the patients about nutrition. Complex carbohydrates may be advisable at the predawn meal, while foods with more simple carbohydrates may be more appropriate at the sunset meal. It is also suggested that intake of fluid must be increased during non fasting hours. The role of physician is also vital in guiding the patient for other aspects such as exercise and termination

of the fast. Strenuous physical activity may result in excessive hypoglycaemia hence it should be avoided, particularly during the 2-3 hours before the sunset. It should be kept in mind that patients should understand that they must always and immediately terminate their fast if symptoms of hypoglycaemia occur.

Conclusions

Fasting during Ramadan is one of the five pillars of Islam and mandatory for all healthy adult Muslims. Ramadan fasting is beneficial in a way that it causes significant reduction in body weight, waist circumference, basal metabolic rate, body mass index, body fat, blood glucose, systolic and diastolic blood pressure and anxiety levels. Ramadan Fasting significantly increases HDL-c, and decreases the plasma cholesterol, triglycerides, LDL-c and VLDL-c. Furthermore, Ramadan fasting decreases the inflammation, pro-inflammatory cytokines IL-1β, IL-6, tumour necrosis factor α and cancer promotion. Among healthy adults, there are no adverse effects of Ramadan fasting on the heart, lung, liver, kidney, eyes, haematologic profile, endocrine and neuropsychiatric and cognitive functions. It is important to educate the subjects who fast during Ramadan, that they must take a suitable nutritious diet and consume sufficient water during Ramadan. It is not only spiritually beneficial, but it has physical, psychological, social and health benefits. However, many Muslim patients with chronic illnesses insist on fasting despite Islamic rules that permit exemption in case of illness. It is important for physicians to have decision-making guidelines when consulted about patient insisting on fasting. Ramadan fasting is a healthy non pharmacological means for improving the cardiovascular and overall health of the individuals. Although it is safe for all healthy individuals, however, those with diseases should consult their physicians and follow the scientific recommendations.

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