

The Effect Of Ramadan Fasting On Glucose And Insulin Homeostasis And Some Biochemical Parameters In Healthy Iraqi Students Of Fallujah Medicine, A Pilot Study

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Abstract

Ramadan is one of the Islamic calendar months, during which Muslims fast. The fasting period, during day hours in Iraq in this year (mid-April to mid-May 2021, Ramadan A.H. 1442) was about 16 hours. The effect of ramadan fasting on insulin and sugar homeostasis (by Homeostasis Model Assessment (HOMA) and some biochemical parameters in healthy Iraqi subjects has not been evaluated. The aim of our research is to find out the fasting effect on plasma sugar and insulin, HOMA indices, some non-protein nitrogen compounds and some minerals among young students adults. The blood samples were taken in the middle of ramadan and about half an hour before breakfast from 25 apparently healthy, Iraqi male, lean students in the faculty of Fallujah medicine, aged of 20-21 years. Fasting sugars, fasting insulin, creatinine, urea, uric acid, Na, K, Ca, & PO₄ were evaluated. HOMA indices and body mass index (BMI) were measured. The fasting of ramadan did not affect the normal values of HOMA indices and some biochemical parameters in the plasma of healthy male students, whose their BMI was within the normal weight. There was a negative correlation between serum levels of fasting insulin with fasting sugar. Our results show no effect of ramadan fasting on HOMA indices, plasma insulin and glucose, creatinine, urea, uric acid, Na, K, Ca, & PO₄ in plasma of healthy Iraqi male students of normal weight.

Keywords: Ramadan, BMI, HOMA, Insulin, Glucose, Non-protein nitrogen compounds, Minerals, Fallujah-Iraq.

Introduction

Fasting during the day in the month of Ramadan, which is the 9th months of the lunar year (Islamic calendar), is obligatory for all Muslims. Fasting is abstaining from eating, drinking and smoking from dawn to sunset, during twenty-nine or thirty days (The Holy Quran. Sura II Al-Baghara, verses 183-187). Ramadan fasting occurs at different times of each solar year, due to the time difference between the lunar and the solar (the Gregorian) calendar (10-11 days before every solar year). The period of fasting

during the day in the month of Ramadan varies from country to country in the world. The fasting period for this year (mid-April to mid-May 2021, Ramadan A.H. 1442) in Iraq was about 16 hours (Trepanowski and Bloomer 2010; Hassanein et al., 2017).

Dozens of previous studies that was conducted on the effect of ramadan fasting on sugars, proteins and lipids intakes, energy, mass of body, body fats percentage of persons of normal weight, visceral adiposity of overweight and obese individuals, fasting blood glucose, and lipid profile in healthy individuals, was collected in tables and published (Osman, Haldar and Henry 2020; Rouhani and Azadbakht 2014). Some research has been done on the effect of fasting during Ramadan on body mass and other physiological properties. Ramadan fasting have no effects on composition of body and the characteristics of metabolic syndrome markers in healthy adult subjects, it's associated with changes in cognition , and drop in diastolic blood pressure (Al-barha and Aljaloud 2018; Harder-Lauridsen et al., 2017; Alsharidah et al., 2016).

Ramadan fasting has multiple health benefits, including reducing cancer incidence, improving bowel diseases, and increasing liver transaminases activity (alanine transaminase, ALT: Aspartate Transaminase, AST), which may lead to improving in non-alcoholic fatty liver disease. reduced body weight, no adverse effects on health status and even improved mental health (Abdeen and Elinav 2021; Zeb et al., 2021). Many previous studies have shown that intermittent fasting has also multiple benefits for many diseases conditions, such as cardiovascular diseases, cancers, neurologic disorders, obesity, and diabetes (de Cabo, and Mattson 2019; Moghadam et al., 2021). Homeostasis Model Assessment (HOMA) is an assessment method for insulin resistance (HOMA-IR), insulin sensitivity (HOMA-S) and beta cells function (of Islets of Langerhans of pancreas) (HOMA- β) from fasting insulin and sugar. It is a steady-state model of sugar and insulin domains, designed from physiological dose responses of insulin production and Sugar uptake (Tara et al., 2004; Niemczyk et al., 2013). Insulin secretion is pulsatile manner in the plasma: relatively constant level of hormone, over a long period, secreted from β -cells of pancreas (Leslie et al., 2015; Richard and Denise 2011).

The blood glucose sources are: 1. The carbohydrates of diet, 2. Glycogenolysis (degradation of glycogen), and 3. Gluconeogeneses (Formation of glucose from various glucogenic compounds, non-carbohydrate sources). Galactose and fructose are converted to glucose in the liver. Insulin have a central role in the

metabolism of sugar, it control the rate of glucose utilization (Richard and Denise 2011; Nakrani, Wineland and Anjum 2021).

Creatinine and uric acid are a breakdown products of creatine and purines respectively, which are a waste products, excreted in the urine. Urea is synthesized in the liver through urea cycle, which is also a waste product excreted in the urine. These non-protein nitrogen compounds (creatinine, urea and uric acid) in the blood, are used clinically to monitor renal function (Richard and Denise 2011). Minerals are inorganic chemical compounds important to the human nutrition, called micronutrients, and are classified into two types: macrominerals (major minerals) and microminerals (trace minerals). The macrominerals (Sodium, Potassium, Calcium, Phosphorus,...) play an important role for our body to stay healthy and are also very important as coenzymes and hormones making (Richard and Denise 2011, FAO/WHO 2001).

Researchers conducted on Ramadan fasting answered the question posed about the effect of fasting on the various systems of the human body and public health of fasting persons. The results of these researches showed beneficial effects of fasting month of ramadan and no negative impact on public health. Therefore, research on the effect of fasting during ramadan on biochemical components in the human blood is of great importance. The objective of our research is to find out the effect of Ramadan fasting on fasting plasma sugar, fasting plasma insulin, Homeostasis Model Assessment (HOMA) indices, non-protein nitrogen compounds, and some minerals.

Materials and Methods:

This descriptive study was used different equipment, devices, and apparatuses: Liason-diasorin XL for insulin, Mindry for sugar, Roche for minerals (Sodium, Potassium, Calcium and Phosphate), and Roche c111 for creatinine, urea, and uric acid. The study was carried out on the lean students of second level, in the faculty of medicine- Fallujah university (Fallujah city-Al-anbar governorate) - Iraq. The subjects of our study were 25 male apparently healthy, who are in the student dormitories of our university, aged of 20-21 years. Venous blood (5 ml) was taken in the middle of Ramadan A.H. 1442 (mid-April to mid-May 2021) and about half an hour before breakfast. It was done by our students in the second stage. The fasting period, during day hours (from dawn to sunset) in Iraq in this mentioned year was about 16 hours.

The body mass index (BMI) was calculated using the formula $BMI = \text{Weight (kg)}/\text{Height (m}^2\text{)}$ (Al-barha and Aljaloud 2018). The BMI was computed by multiplying the weight (kg) by the square of the height (in meters) and was classified in accordance with the World Health Organization (WHO 2021), international classification system: Underweight (less than 18.5 kg/m^2), Normal Weight ($18.5\text{--}25 \text{ kg/m}^2$), Overweight ($25\text{--}30 \text{ kg/m}^2$).

HOMA-IR was determined using the equation of wallace et al. (Tara et al., 2004):

$HOMA-IR = \text{Fasting Plasma Insulin (uIU/mL)} \times \text{Fasting Plasma Glucose (mmol/L)} \div 22.5.$

1.0 (0.5–1.4) on the healthy scale

The ideal range is less than one, indicating that you are insulin-sensitive.

Early insulin resistance is indicated by a value of more than 1.9.

Insulin resistance is indicated by a number greater than 2.9.

$HOMA- \beta = 20 \times \text{fasting insulin (}\mu\text{IU/ml)}/\text{fasting glucose (mmol/L)} - 3.5.$

Normal insulin 0-25 mIU/L, normal Glucose 3.9-5.8 mmol/L ($3.9 \times 18 = 70.2 \text{ mg/dl}$, $5.8 \times 18 = 106.2 \text{ mg/dl}$).

Normal value of: creatinine (0.3-1.0 mg/dl), urea (20-45 mg/dl), uric acid (3-7 mg/dl), Na (133-146 mmol/L), K (3.5-5.3 mmol/L), Ca (8.4-11.6 mg/dl), PO_4 (3.5-5.5 mg/dl).

The mean and standard deviation for all parameters were calculated. The descriptive statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS, Windows version 25) software.

Results:

The participants of our study are twenty five healthy male students (20-21 years old) at second level in the faculty of medicine/Fallujah university-Iraq. The body mass index (BMI) measured during the period of the study in the middle of Ramadan month A.H. 1442 (April-May, 2021).

Table 1 shows the data as mean \pm SD. According to the international classification system, it is within the normal range value ($21.61.47 \text{ kg/m}^2$) (FAO/WHO 2001).

Fasting plasma insulin and fasting plasma glucose analysis revealed that the mean \pm SD of insulin ($5.15 \pm 2.1 \text{ uIU/mL}$) and of glucose ($85.32 \pm 14.5 \text{ mg/dl}$). There was a negative Pearson's Correlation between serum level of fasting insulin with fasting glucose (-0.607 , $p < 0.001$) at P value (0.001). The Homeostasis Model Assessment was used to assess insulin resistance (HOMA-IR) and β -cell function (HOMA- β). The results of HOMA-IR (1.042 ± 0.37) and HOMA- β ($83.33 \pm 12.67\%$), were presented in the table 1.

Table 1. Shows the description of parameters regarding fasting in Ramadan.

Parameters	Units	Mean ± SD
BMI	kg/ m ²	21.6±1.47
Fasting plasma glucose	mg/dl	85.32±14.5
Fasting plasma insulin	uIU/mL	5.15±2.1
HOMA-IR		1.042±0.37
HOMA- %β	%	83.33±12.67

The results of effect of ramadan fasting on non-protein nitrogen compounds (creatinine, Urea and Uric acid) and some minerals (Na, K, Ca, and PO₄), were presented in the table 2. The non-protein nitrogen compounds: Creatinine (0.72±0.1 mg/dl), Urea (29.51±7.9 mg/dl) and Uric acid (5.26±0.6 mg/dl). The minerals: Na (141.28±3.5 mmol/L), K (4.04±0.2 mmol/L), Ca (9.26±0.1 mg/dl) and PO₄ (4.52±0.5 mg/dl).

Table 2. Shows the impact of fasting throughout Ramadan on non-protein nitrogen compounds and some minerals.

Parameters	Units	Mean ± SD
Creatinine	mg/dl	0.72±0.1
Urea	mg/dl	29.51±7.9
Uric acid	mg/dl	5.26±0.6
Sodium	mmol/L	141.28±3.5
Potassium	mmol/L	4.04±0.2
Calcium	mg/dl	9.26±0.1
Phosphate	mg/dl	4.52±0.5

Discussion:

To our knowledge, this is the first study in Iraq to look at the effects of Ramadan fasting on glucose and insulin homeostasis in healthy people using HOMA indices. Our study was done to find out how fasting during Ramadan affects insulin and glucose homeostasis by using homeostasis model assessment (HOMA) and on some biochemical parameters (non-protein nitrogen compounds and minerals) in healthy Iraqi students at faculty of medicine (Fallujah university). The body mass index (BMI) of our participants (aged 20-21 years) was measured in the middle of Ramadan ($21.6 \pm 1.47 \text{ kg/m}^2$), It is in the normal range value. The results of some previous studies showed no change in the body weight of healthy subjects through and after Ramadan (Aksungar et al., 2005; Ongsara et al., 2017). On the other hand, according to a meta analysis of 70 studies, there is a clear correlation between starting BMI and weight reduction throughout the fasting period (Fernando et al., 2019).

Glucose serves as the primary source of metabolic energy for mammalian cells, and as the major precursor of different compounds (ribose, glycoproteins,...). The amount of blood glucose must be kept within strict limits. In the absence of carbohydrate in the meal, the liver feeds glucose to the blood through gluconeogenesis, and liver glycogen, an essential source of glucose, can only supply these demands for 10-18 hours. Therefore, the average fasting blood glucose concentration is between 80 to 90 mg/dl (Nakrani, Wineland and Anjum 2021; Leszek Szablewski 2017). Our study indicates that Ramadan fasting does not affect the normal level of glucose ($85.32 \pm 14.5 \text{ mg/dl}$) and insulin ($5.15 \pm 2.1 \text{ uIU/mL}$) in the blood of healthy male students, which is in agreement with several studies (Harder-Lauridsen et al., 2017; Mohammadzade et al., 2017; Abdullah, AL-Habori, and Al-Eryani 2020; Gnanou et al., 2015). On other hand, according to the findings of Gnanou et al., (Gnanou et al., 2015). Ramadan fasting can aid in glucose homeostasis in young men in good health. There was a negative Pearson's Correlation between serum level of fasting insulin with fasting glucose (-0.607 , $p < 0.001$). A -1 correlation coefficient means that for every positive increase in one measure, a certain proportion of the other measure falls.

Insulin resistance (IR) and beta cell function were identified by HOMA. HOMA reflected the balance between β -cell insulin secretion and hepatic glucose production during the homeostatic state. The HOMA-% β is a fasting plasma insulin and glucose concentrations-based measure of insulin secretory function (Michael Vogeser et al., 2007; Cersosimo et al., 2014). Our results in table 1, shows that the HOMA-IR is in the healthy range (1.042 ± 0.37), and is in the optimal insulin sensitivity (Tara et al., 2004;

Gnanou et al., 2015). Table 1 shows that HOMA-% β is also in the healthy range ($83.33\pm 12.67\%$) (Cersosimo et al., 2014; Garg, Dutta and Mahalle 2011).

In the present study, the results of non-protein nitrogen compounds in the blood of healthy fasting students were within the normal ranges: Creatinine (0.72 ± 0.1 mg/dl), Urea (29.51 ± 7.9 mg/dl), and Uric acid (5.26 ± 0.6 mg/dl). These results consistent with the previous studies in healthy guys, the effect of Ramadan fasting on serum creatinine, urea, and uric acid did not differ from the normal range (Al Hourani et 2009; Unalacak et al., 2011; Beltaief et al., 2019).

The minerals studied in the students' blood during the 16-hour fasting period were found in their normal values. The results of Na (141.28 ± 3.5 mmol/L), K (4.04 ± 0.2 mmol/L), Ca (9.26 ± 0.1 mg/dl) and PO_4 (4.52 ± 0.5 mg/dl) are in agreement with the previous studies (FAO/WHO 2001; Abdullah, AL-Habori, and Al-Eryani 2020). Vitamin D and hormones (Calcitonin and Parathyroid Hormone) play a key function in calcium and phosphate regulation in our body (Richard and Denise 2011; FAO/WHO 2001). Sodium and potassium are regulated by aldosterone and insulin, therefore fasting throughout Ramadan appears to have a positive effect on blood pressure (Richard and Denise 2011; FAO/WHO 2001; Al-Jafar et al., 2021).

Conclusions: Our results show no effect of ramadan fasting on HOMA indices, plasma insulin and glucose, creatinine, urea, uric acid, Na, K, Ca, & PO_4 in plasma of healthy Iraqi male students of normal weight. Fasting's influence on other biochemical indicators in healthy and sick patients may require a larger representative sample in a future national investigation.

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