Hydration Status and Liver Function of Young Men Before and After Ramadan Fasting

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ABSTRACT

The objective of this study was to identify and analyse the hydration status and liver function of young men before and during Ramadan fasting (RF). The study design was a prospective cohort into 1st period (one week before fasting) and 2nd period (the last ten days of fasting). The subjects were 18 healthy young men (19-30 years old). Data on dietary intake were collected using food record 3x24h, body composition were collected using bioelectrical impedance analyser (BIA), hydration status, and liver function data were measured trough urine and blood sample. This study showed significant differences in body weight, fat body mass, body mass index (BMI), body water, intake of energy, protein, fat, carbohydrate, and water, hydration status (serum osmolality and urine density), and liver function (SGOT and SGPT levels) before and during RF ($p < 0.05$). There were significant correlation between fasting status and SGPT levels ($p < 0.05$). The study concluded that Ramadan fasting has a positive effect to control body weight and improve liver function measured by SGOT and SGPT levels.

Keywords: hydration status, liver function, Ramadan fasting, young men

INTRODUCTION

More than 60% of the human body consists of water (Buyckx 2007). Water is an essential nutrients which has an important function for physiological and biochemical metabolism. Water function as a transport substance, metabolic heat absorbent, blood volume circulation maintainer, and as a detoxification agent to remove metabolic toxin in the body. Trial in animal studies have shown that the hydration status in the cell have a pivotal role in cell functions, hormones, oxidative stress, and nutrition which then can affect the metabolism and gen expressions. Long-term dehydration without proper treatment may trigger metabolism malfunctions manifest in the body biomarkers (Firmansyah 2015).

Water intake is influenced by many factors such as age, genetics, gender, thirst mechanism, water availability, and sociocultural as well as religious factors (Contento 2011). Ramadan is a holy month in which Muslims have to restrict eating and drinking during the fasting period from dawn to dusk (Alinezhad & Salehi 2016).

Mohamed *et al.* (2013) stated that Ramadan fasting (RF) may modifies diet in many ways such as trough changes in the feeding frequency, selection of food type, food preparation, and eating habits. There is a higher risk for dehydration for Muslims who conducted this RF due to the restriction for consumption of all types of foods and beverages (fluid) for about 12 hours (Trepanowski & Bloomer 2010).

The Indonesian Regional Hydration Research Study (THIRST) shows that even in normal conditions (not fasting), 44.5% of Indonesian adult subjects (25-55 years old) from two different ecological region (highlands and lowlands) already suffered from mild dehydration (Gustam *et al.* 2012). Recent study on hydration status during RF conducted by Hardinsyah *et al.* (2017b) has shown that the subjects only drank 2042.90±452.61 ml/day of total water, or 91% of their water requirement. This study also found that in late afternoon near the time of *iftar*, the body actually has the highest water requirement (Hardinsyah *et al.* 2017b).

While in the other hand, some studies has found that RF have benefited the physical and mental health. Fasting is described to have a positive effect for lipid profile and other haematological parameters (Fararjeh *et al.* 2012). RF also shown to lower the level of anxiety, frustration, and depression (Mousavi *et al.* 2014). Another benefit of RF is as a natural detoxification process which largely happened in the liver. Liver has a capability to clean the blood from toxins, bacteria, viruses, parasites, tumour cells, and foreign particles that may harm the body (Hardinsyah 2011). Liver function during RF is shown to be getting better. Levels of serum glutamic oxaloacetic transaminase (SGOT) and serum glutamate pyruvate transaminase (SGPT) was lower after RF (Wahjoetomo 1999 in Hardinsyah 2011). Therefore, this study aimed to identify and analyse the nutritional status, body composition, food intake, fluid consumption, hydration status, and liver function of the subjects before and during RF. Further, this study also aimed to analyse the correlation between RF to hydration status

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and liver function, and of hydration status to liver function.

METHODS

Design, location, and time

The study design was a prospective, divided into two periods, 1st period was one week before RF and 2nd period was the last 10 days of RF. This study was conducted in Bogor Agricultural University (BAU) from May to July 2016. This study was a joint research of "*Water Intake and Hydration Status of Adults Before and During Ramadan Fasting*" chaired by Prof. Dr. Ir. Hardinsyah, MS.

Materials and tools

Subjects chosen for the study were young male adult because they were more likely to finish the RF (28-30 days) without any missed time due to menstruation women. They were young student of BAU. The inclusion criteria for this study were male, 19-30 years old, BMI 18.5-27 kg/m², in healthy condition, non-smoker, willing to be a subject and fully participate in this study and willing to approve the informed consent. The exclusion criteria were subjects with a certain health conditions which can impede the commitment to finish the full RF.

Data collection

The primary data collected at each periods of the study were 1) dietary intake, collected using food record 3x24 hours; 2) nutrition status, measured using CAMRY EB9003 for body weight and stature meter for body height, and bioelectrical impedance analyser (BIA) for body composition; 3) hydration status, measured using serum osmolality and urine specific gravity (USG); 4) liver function, measured using level of SGOT, SGPT, albumin serum, and bilirubin urine. The ethical clearance letter for the study is issued by the Faculty of Medicine University of Indonesia (number of 440/UN2.F1/ETIK/2016).

Body weight and height measured twice or more until the measurement was consistent. While measurement of other data was only carried in once. Body height was measured only in 1st periods of this study with the assumption that no significant changes in height occurred between the 1st and 2nd period. The types of liver function biomarkers used in this study were 1) transport function of the organic substance test and drug metabolism using the bilirubin urine test, 2) cell or liver tissue damage test using SGOT (an enzyme that found more in mitochondria and cytoplasm) and SGPT levels test (an enzyme that only found in cytoplasm), and 3) biosynthesis function test using albumin serum test. Urine sample was collected in the day time (12.00-13.00) and in the afternoon (16.00-17.00). It was collected using

sealed glass bottle about 25-30 ml and then was analysed in BAU urine analysis laboratory using urine chemistry analyser (DUS R-300).

Blood sample was collected in the morning (08.00-10.00) at the 1st periods of this study and after *iftar* with drinking water at the 2nd periods of this study. Blood was drawn by trained medical personnel, about 5 ml using syringe then blood centrifuged to separate the plasma and serum.

Serum sample was put into the micro tube and cooler box with maximum temperature of 7°C, then it analysed at Amerind Bio-Clinic (ABC) Jakarta laboratory and laboratory clinic of PKU Muhammadiyah Bogor. Sample was analysed using osmometer automatic to measure serum osmolality data. While Photometric UV-test was done for measuring the SGOT, SGPT, and albumin serum level.

Data Analysis

Data were processed using *Microsoft Excel 2010* and analysed using SPSS 16.0 version. Difference test between variables before and during RF was conducted using paired t-test and Wilcoxon. Regression test was done using multiple linear regression.

RESULTS AND DISCUSSION

Characteristic of subjects

Subjects were 18 men with the average age of 22.0±2.4 years old and all subjects were a BAU student (100%), 72.2% were undergraduate student and 27.8% were postgraduate student. The average allowance were 1,240,000±1,060,000 (IDR) per month. 61.1% of subjects allocated more than 450,000 (IDR) for foods and 72.2% allocated less than 152,000 (IDR) for beverages per month.

Nutrition status, body composition, and nutrition intake before and during Ramadan fasting

The result found that body weight, total body fat, visceral fat, total body water, and BMI during RF were significantly decreasing ($p < 0.05$) (Table 1). This result was in line with study by Syam (2016). Decreasing of body weight was caused by decreasing of body water and body fat percentage during fasting. Reducing of body water caused by body water alteration during RF. These may increase risk of dehydration (Mazidi *et al.* 2014).

RF has shown to decrease carbohydrate intake and carbohydrate oxidation and thus increase the fat oxidation. The restriction of nutrition intake induced the body to use stored energy (glycogen) and fat deposits as energy resources during RF. Fat percentage decreased was the visceral fat or fat around the abdominal cavity (tummy fat). These fat has the highest rate of lipolysis

Table 1. The distribution of subjects based on nutrition status, body composition, and nutrition intake before and during RF

Variables	Before RF (n=18)	During RF (n=18)	Delta	p
	Median±SD	Median±SD		
Body height (cm)	166.4±4.9	166.4±4.9	0	1.000
Body weight (kg)	61.4±6.9	60.4±7.3	-1.1	0.001*
Body fat (kg)	13.1±4.6	12.7±4.7	-0.4	0.046*
Visceral fat (kg)	5.6±2.2	5.20±22.1	-0.4	0.002*
Total body water (kg)	35.5±3.0	34.8±2.9	-0.7	0.001*
BMI (kg/m^2)	22.3±2.2	21.8±2.3	-0.5	0.000*
Intake				
Energy (kcal)	1,950±503	1,709±367	-240	0.019*
Protein (g)	63.0±15.3	54.3±14.9	-8.7	0.005*
Fat (g)	64.5±17.6	48.4±16.9	-16.2	0.000*
Carbohydrate (g)	288.8±82.3	262.3±71.4	-26.5	0.024*

* Significantly paired t-test in p<0.05

during fat oxidation (Sinaiko 2007). Increase in fat oxidation occurs due to the decrease of nutrition intake during RF, refer to Table 1.

There is a significant decrease in nutrition intake (energy, protein, fat, and carbohydrate) during RF (p<0.05). Hardinsyah (2011) stated that in general the amount of calories which goes into the body was in limited amount during fasting. People only eat 75-80% from the daily calorie intake, therefore after RF the body weight decrease in about 5-10%. Lower nutrition intake during RF happened because of the limited time to eat and choices of types of food. Study by Unalacak *et al*. (2010) showed that restriction of nutrition intake was caused by the changing of eating pattern, from 3 times per day to 2 times per day, thus reduce the total energy intake.

Water intake, water intake level, and hydration status before and during Ramadan fasting

There was a significant differences of water intake and water intake levels before and during RF (p<0.05) (Table 2). Most of the subjects have low water intake levels (<90%) during fasting. These caused by limitation of all types' food and beverages during fasting about more than 12 hours (Trepanowski & Bloomer 2010). Al-Arouj *et al*. (2010) recommended to increase water intake during no fasting time and *sahoor* time. People should have enough drink at the end of *sahoor*, before fasting time and when *iftar* time in order to prevent the risk of dehydration.

Hydration status in this study was measured using 2 methods, serum osmolality and USG which were gold standard measurements for hydration status using blood and urine samples. There was significant decrease in serum osmolality level during fasting (p<0.05). The majority of subjects had normal serum osmolality levels (euhydration). These condition occur due to the homeostasis mechanism during fasting, so that serum osmolality is able to be maintained in normal levels. Hosseini *et al*. (2013); Dikme and Dikme (2016) pointed that there was no signifi-

cant differences in osmolality serum before and during RF. Unchanging serum osmolality may be caused by normal levels of plasma sodium or the balance condition of fluid and sodium. Increasing of serum osmolality can occur due to the hypernatremia or excess of sodium intake (Kuwabara *et al*. 2017).

Hydration status based on USG level shows that before and during RF all subject were suffering from dehydration (100%). These because the subjects had the same water intake ha-bits before and during RF. These result was in line with Hardinsyah *et al*. (2017b), that all subjects were suffering from dehydration and was worse during fasting, especially in the afternoon near iftar time based on the USG levels. There was no positive correlation between serum osmolality and USG. Less subjects were categorized as having dehydration based on osmolality levels compared to the USG levels. These can be explained by the homeostasis mechanism in body.

Changing of osmolality activates the osmoreceptor, so that can increase the antidiuretic hormone (ADH) and stimulate the thirsty mechanism. Increasing of osmolality can causes dehydration and become more severe without immediate fluid consumption during fasting. These induced the kidney to reabsorb water for maintenance and fluid balancing in the body, so the urine will decrease in volume and be more concentrated and the body water will at normal level (Hardinsyah *et al*. 2017a).

The present of this mechanism was confirmed by data on subject's dehydration symptoms of this study. More subjects claimed decrease in urine volume and more concentrated urine during the RF. In addition, self-urine check cards result also showed that more subject had more concentrated urine colour during fasting.

Liver function before and during Ramadan fasting

Table 3 shows significant decrease in SGOT and SGPT level during fasting (p<0.05).

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Table 2. The distribution of subjects based on water intake, water intake levels, and hydration status
before and during Ramadan fasting

Variables	Before fasting	During fasting	p
Water intake (mean±SD)	2571.7±373.7	2305.5±337.3	0.000*
Water requirement (mean±SD)	2701.4±239.2	2503.1±231.8	
Water intake level (mean±SD)	95.2±15.6	85.4±14.6	0.000*
Severe (<90%) (n(%))	8 (44.4%)	12 (66.7%)	
Normal (≥90%) (n(%))	10 (55.6%)	6 (33.3%)	
Total (n(%))	18 (100%)	18 (100%)	
Serum osmolality (mean±SD)	319±7.0	315±4.9	0.010**
Euhydration (<320 mlosmol/kgH₂O)(n(%))	12 (66.7)	17 (94.4)	
Dehydration (≥320 mlosmol/kgH₂O)(n(%))	6 (33.3)	1 (5.6)	
Total (n(%))	18 (100.0)	18 (100.0)	
USG (mean±SD)	1.016±0.00	1.022±0.00	0.001**
Euhydration (USG<1.015 g/mL) (n(%))	0 (0.0)	0 (0.0)	
Dehydration (USG≥1.015 g/mL)(n(%))	18 (0.0)	18 (0.0)	
Total (n(%))	18 (100.0)	18 (100.0)	

* Significantly paired t-test in p<0.05, **) Significantly Wilcoxon test in p<0.05

These results indicated that the liver was working more lightly and had lower risk to cell damage during fasting. Study by Wahjoetomo (1994) in Hardinsyah (2011) and Nasiri *et al.* (2016) also found that SGOT and SGPT serum levels during fasting were lower than before fasting.

Some factors that may increase the SGPT levels are excess of fat intake, alcohol consumption, smoking habits, and free radicals exposed (Hardinsyah 2011). Subject in this study were non-smokers and consume no alcohol. Subject's fat consumption was not in excess, it was ≤91 g based on RDA (2013). So the decreasing of SGPT levels in this study was explained by the fasting done by subject during the Ramadan holy month. Exposure of free radicals in this study not only from cigarette smoke but also from food and energy metabolism in the body. Food like carbohydrate, fat, and protein sources will be breakdown to form energy, so it needs large amount of oxygen capacity. Increasing oxygen will lead to production of free radicals in the body. When the metabolism is increasing, detoxification organ performed in heavier task (Hardinsyah 2011).

Carbohydrate, fat, and protein intake before and during RF in this study were significantly different and decrease during fasting, so the free radicals exposure and toxin from food were low. Therefore, the optimum cell regeneration process will happen and the detoxification organ carries lighter task (Hardinsyah 2011). These process was characterized by the decrease in SGOT and SGPT levels in the liver tissue (Table 3).

SGOT is an enzyme which helps the gluconeogenesis process in the mitochondria. When the carbohydrate intake is low during fasting, the body will breakdown the energy storage (fat) in the body to produce the glucose as an energy source for activities. As a result the SGOT enzyme is required in optimum amount as a catalyst. During fasting the breakdown of fat to energy (gluconeogenesis) still under control, so

the secretion of SGOT was not too high like in normal time. It means that the liver was working lighter through the recycle of the energy deposits in the body during fasting (Thapa & Walia 2007).

SGPT is an enzyme which produced by liver tissue and has higher activity in the liver. The significant decrease of SGPT in this study occurred due to the lowering of glycolysis process in the cytosol, this was caused by restriction of carbohydrate intake during fasting and the body uses glycogen in limited quantities for glycolysis. Cytosol is the site of glycolysis and SGPT is the key enzyme. So that when intake of carbohydrate was restricted and so was the glycolysis, the SGPT enzyme excretion would also be going down (Thapa & Walia 2007).

Table 3 also shows that there is a tendency of decline in albumin serum level, but no significant differences (p>0.05). These results were in line with study by Mohammed (2011) and Kamal *et al.* (2012) who found that there was no significant differences between albumin level before and during RF. Decreasing of albumin level was suspected by proteolysis from gluconeogenesis. There no decrease of body muscle percentage, but only decreasing in energy resource and body fat percentage in the body (Syam 2016).

The other test of liver function was bilirubin urine. The result showed that there was no bilirubin found in the most of subject's urine. Study by Mohammed (2011) also found that there was no significant differences before, during, and after RF. The existence of bilirubin content in subject's urine indicated the damage of liver tissue or increasing of haemoglobin breakdown.

The regression of fasting status and hydration status to liver function

Table 4 shows the multiple linear regression analysis was used to analyse the correlation of fasting status and hydration status (serum osmolality and USG) to liver function (SGPT

Table 3. Liver function (mean±SD) before and during RF

Variable	Before fasting (n=18)	During fasting (n=18)	Delta	p
SGOT (U/L)	21.3±5.8	18.9±4.7	-2.4	0.000*
SGPT (U/L)	25.8±6.7	21.2±6.2	-4.7	0.000*
Albumin (g/dl)	4.2±0.2	4.1±0.1	-0.02	0.717
Bilirubin n(%)				
Negative	17 (94.4)	17 (94.4)		
Positive	1 (5.6)	1 (5.6)		

*) Significantly paired t-test in p<0.05

Table 4. The regression of fasting status and hydration status to liver function (SGPT level)

Model		Unstandardized Coefficients		Standardized Coefficients	T	p
		B	Std. Error	Beta		
1	(Constant)	-83.419	54.547		-1.529	0.136
	Fasting status	-2.838	2.084	-0.221	-1.362	0.183
	Serum osmolality	.343	0.171	0.326	2.004	0.053
2	(Constant)	-491.394	302.720		-1.623	0.114
	Fasting status	-6.826	2.620	-0.532	-2.605	0.014*
	USG	508.609	297.673	0.349	1.709	0.097

* Significant multiple linear regression in p<0.05

level). The result shows that fasting status effect SGPT level more compared to hydration status (p<0.05). Hydration status in this study was not affecting the SGPT level, because water a direct antitoxins in the body. Water may speed up toxin clearance by functioning as solvent therefore water can help in filtration and excretion of body fluid by kidney resulted in urine secretion (Hardinsyah 2011).

SGPT level was significantly affected by fasting status through the nutrients metabolism during fasting. The decrease in carbohydrate intake during fasting because of the limited time for eating lowers the SGPT enzyme secretion (Thapa & Walia 2007) (Trabelsi et al. 2011).

CONCLUSION

Ramadan fasting had positive effect for decreasing of BMI through the lowering of the body fat percentage because of energy, protein, fat, and carbohydrates intake are restricted. Most of subjects had severe hydration status (dehydration) during RF. The bad drinking habits before and during fasting explained this result. Another benefit of RF is that the liver function became better. It was characterized by the lowering of SGOT and SGPT levels. The benefits of RF appeared when the nutrients intake was balance each day.

The limitations of this study were the small number of subjects, done without control subjects and the hydration status was measured only in a week before fasting and the last 10 days of fasting. Therefore, future research should look into fluctuation in hydration status during RF, and the study must conducted in large number of subjects and in various subjects with different hydration status.

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