ORIGINAL ARTICLE

Hydration Status of University Students in the Fasting Month of Ramadan

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ABSTRACT

Introduction: Islamic fasting is widely advocated for its health benefits around the world. According to the Holy Quran, it is prescribed by The Almighty Allah (God) for the Muslim to fast in the holy month of Ramadan of the Islamic Calendar every year. Aim: This study aimed to assess the hydration status of the students who were performing their fasting during the holy month of Ramadan. **Methods:** Thirty male and female students at the International Islamic University Malaysia (IIUM) Kuantan Campus volunteered to participate in this study. All study participants were of healthy and normal body mass index (BMI) according to the WHO classification. Their hydration status was assessed using a bioelectrical impedance (BIA) instrument. This was done before, during, and after fasting, on specific adjusted time post meal. The collected data were compiled and statistically analysed. **Results:** The results indicated that the total body water (TBW) was increased without affecting the balance of intracellular water (ICW) and extracellular water (ECW) of the fasting study participants. **Conclusion:** This study indicates that Islamic fasting does not cause a reduction in TBW in fasting individuals. The TBW is maintained due to the burning of body fat.
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Keywords: Hydration Status; Students; Islamic Fasting; Ramadan

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INTRODUCTION

Islamic fasting is a type of intermittent fasting (1) practiced by muslims in Ramadan. Fasting is practiced in most religions of the world but Islamic fasting is unique in many ways since it has different aspects; the physical (refraining from food, sex, and vulgarity, etc.), spiritual (enhancing ibadah and taqwa or righteousness) and social (sharing foods, doing charity, and giving sadaqah to the needy). These actions somehow contribute to good health, as evidenced by the scientific literature. In Islamic fasting, Muslims would fast from sahur (before dawn) to Maghrib (after sunset) and the duration varies from country to country depending in which part of the globe they reside. This would mean some people may have longer duration than others. Similarly, some may be fasting during a cold winter while others might have extremely hot weather. Therefore, the effect of physical conditions of observing fasting cannot be generalised as such to be thirsty or hungry in these different scenarios. One of the concerns of fasting is the effect on the hydration status of the fasting person. In fasting, when the fat is utilized for energy, it would release water which adds to the body pool of water considerably (2-4). Fat mass is reduced in overweight/obese fasting individuals (5) and this has been shown to be negatively associated with the body TBW. It has been observed that a shift of water between the two compartments occurs. Previously, a strong positive correlation (r=0.9) between the fat free mass and total body water and negative association (r=-0.9) with total body water was observed in the fasting respondents (6). However, this effect cannot be generalized among the fasting individuals and remains questionable since some the studies report no effect in normal-weight individuals (7). The hydration status of a fasting person depends on his personal habit and the climate one lives in (8). The changes in the total body water remains statistically insignificant in fasting individuals (9). Keeping in view the available literature on the effect of fasting on the hydration status in fasting individuals, this study was designed to assess the hydration status of normal weight young adults in the fasting month of Ramadan.

MATERIALS AND METHODS

Study Design and Respondents

This was an observational study involving 30 young Malaysian adults (15 male & 15 female) in the age range of 20-24 years. The respondents were conveniently recruited at the International Islamic University Malaysia (IIUM) Kuantan Campus. Both the male and female respondents were healthy university students however, their physical activities and food/fluids intakes were not recorded.

Ethical Considerations

This study was approved by the IIUM Research Ethics Committee (IIUM IREC). The respondents voluntarily consented to be included in this study after the aim and procedure of the study were explained to them.

Inclusion & Exclusion Criteria

The inclusion criteria included having normal body mass index (BMI) (18.5–22.9 kg/m2) based on the World Health Organization (WHO)'s classification (9) as shown in the Table I . In the present study, only healthy students with no medical conditions and on no medications were included. Apart from this should be healthy and must be fasting in Ramadan. On the other hand, the exclusion criteria comprised of being underweight, overweight, or obese, married, pregnant, or was menstruating due to the difference in water distribution (11-12) and the ones who were not fasting.

Table I: Obesity classification according to the WHO (2004)

Category	BMI
Underweight	<18.5
Normal	18.5–24.9
Overweight	25–29.9
Obese	≥30

Data Collection

The data collection was performed in three stages: i) one week before Ramadan, ii) final week of Ramadan, and iii) one month after Ramadan, according to the schedule described in Table II.

Table II: Data collecting schedule/timing

Data Collection Period	Timing
Before Ramadan	09:00 AM – 01:30 PM*
During Ramadan	09:00 AM – 11:00 AM*
After one month of Ramadan	11:00 AM – 06:30 PM*

*The timing depends on the 3-5 hours after taking meals in all phases taking into consideration the liquid and solid meal emptying duration of the stomach (10-11)

Height and body weight were measured using a stadiometer (SECA, Germany) while body water was estimated using a bioelectrical impedance analyser or BIA (Maltron Bioscan 916S). Physical activities and food /fluids intakes were not recorded for the respondents.

Bioelectrical Impedance Analysis (BIA)

The assessment body composition and total body water content by the BIA uses the electrical conduction properties of various tissues. It is mainly based on the electrolytic differences between fat and fat-free mass tissues. While using BIA, electric current is passed through body which is opposed by the non-conducting tissues/cells containing fat and is only transmitted by electrolytes dissolved in water (13). Therefore, by definition, the impedance (Z) is the resistance to the flow of electrical current and it relies on the frequency of the current applied. It depends on two vectors resistance (R) and reactance (Xc) as described (14-15). As it is required for BIA measurements that the subjects were normally hydrated (13) with constant/uniform temperature/composition of electrolytes and water and remain for 3-5 hours post meal consumption (16). When an individual's body composition is assessed using BIA in the recent 3-4 hours after meal, it can cause a reduction in impedance by less than 3% (11-12). All the respondents were requested not to perform any strenuous exercise 12 hours prior the measurement and also not to consume any caffeinated beverages in order to minimize water loss.

The BIA measurements were made according to the instructions of the manufacturer. The study participants' body weight and height were measured prior to the BIA performance. After removing socks and any metallic items, they would then be asked to lie down quietly in a prone position with the arm placed 30° from the body and leg separated 45°. As indicated in the Figure 1 the electrodes were placed on the right hand and foot. The electrodes were cleaned after each analysis. The BIA was performed thrice within the aforementioned time scheduled for the respondents.

Statistical Analysis

Statistical analysis (repeated measure analysis of variance) was performed using SPSS (version 17.0). The mean was ascertained at 95% CI (P<0.05) using post-hoc test.

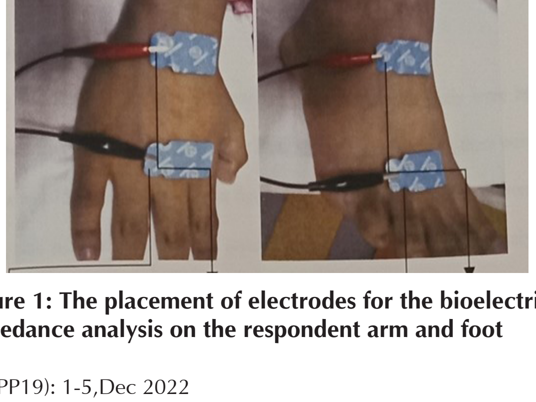

Figure 1: The placement of electrodes for the bioelectrical impedance analysis on the respondent arm and foot

RESULT

The findings of the three data collection periods (before, during and after Ramadan) are presented in Figures 2 and 3, as well as in Tables III and IV. Body weight reduced by 1.31% and correspondingly the BMI was reduced by 2.12%. The reduction was consistently observed in all respondents and the differences were significant ($P<0.05$) between before and during fasting.

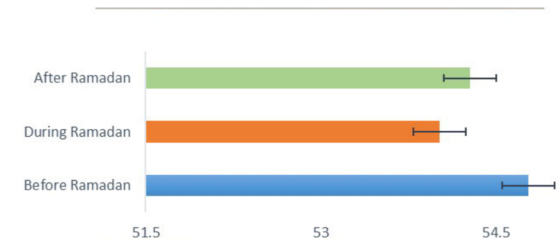

Figure 2: Effect of Ramadan Fasting on Respondents body weight

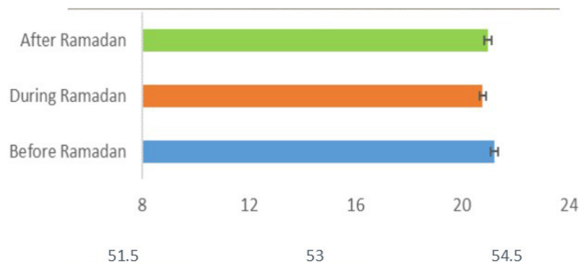

Figure 3: Effect of Ramadan Fasting on Respondents BMI

Table III:Table III Comparison of the Islamic fasting on bodyweight and BMI (N=30)

	Difference Between Before and During Ramadan		Difference Between During and After Ramadan	
	Mean Difference ± SE	Change (%)	Mean Difference ± SE	Change (%)
Body-Weight Difference (Kgs)	-0.72 ± 0.26*	-1.31	0.22 ± 0.27^{NS}	0.41
BMI difference (Body Weight Kgs)/(Height Meter)^2	-0.45 ± 0.10**	-2.12	0.19 ± 0.08*	0.91

NS = Non-Significant. * = Significant at 95% CI (P,0.05) and **= Significant at 95% CI (P,0.01)

The hydration status of the respondent is presented in the Table IV and the data reveals that the total body water pool was significantly ($P<0.01$) increased whereas the intracellular water was reduced. However, there was a bigger variation among the respondents. Interestingly, the total fat was significantly ($P<0.01$) reduced among the respondents. These observations are reversed after one month of Ramadan fasting.

Table IV:Table IV Comparison of the Islamic Fasting on Body-Water and Fat Mass

	Difference Between Before and During Ramadan		Difference Between During and After Ramadan	
	Mean Difference ± SE	Change (%)	Mean Difference ± SE	Change (%)
Total Body Water	2.53 ± 0.68**	4.74	-1.25 ± 0.71^{NS}	-2.24
Extra-cellular Water	1.01 ± 087 ^{NS}	2.4	0.62 ± 0.57 ^{NS}	1.46
Intra-cellular Water	-2.38 ±1.55 ^{NS}	-4.07	0.85 ± 1.43 ^{NS}	1.51
Fat Mass	-1.29 ± 0.32**	-11.55	1.05 ± 0.51	10.33

NS = Non-Significant. * and **= Significant at 99% CI (P,0.01)

DISCUSSION

The observed effect of Islamic fasting on hydration status is of clinical importance particularly the increased total water pool and the reduced fat mass which probably contribute to the water loss through various routes. Furthermore, there appears to be shift of water between the two compartments (ECW and ICW). The increase of water pool seems to be at the expense of fat reduction. From this study we could infer that 1) there is no reduction in TBW in fasting, 2) there is fat reduction in fasting and 3) there is a shift of water between the water compartments.

The increase in the TBW relates to the loss of body fats as observed in the present study and earlier studies (5-6). The question is that whether the loss of body fat during Ramadan fasting is associated with the TBW. In the literature, a negative association between body fat and TBW has been reported. When body fat decreases, the TBW increases, and vice-versa. A systematic review shows that a considerable amount of fat mass is lost in Ramadan whereas only 4.3 - 38.3% of fat-free mass is lost in obese fasting individuals depending upon their diet and exercise (17). It is understood that when there is lipolysis, essential water is added to fats which cause the release of fatty acids from triglycerides into the blood. The oxidation of the free fatty for the purpose of energy will release water and that may contribute to the pool of TBW. This is a well-established fact and is documented in literature and textbooks. The same is probably happening in fasting individuals during Ramadan. The observed reduction in the ICW is probably the beneficial factor in fasting people. This factor is consistently observed in this study as well as in a previous study conducted by our group (6). This reduction has not been identified as detrimental for healthy individuals who are voluntarily fasting (18) and can be true for the respondents of this study who were health university students. The hydration status depends on geographical location, duration, weather and profession. The respondent in this study were university students who spend most time being indoor. Therefore, this study actually does not represent all the fasting muslims. It will be worthwhile to have a multicentres study involving different geographical location, fasting duration, weather, and profession.

Limitation of the Study

In the current study the assessment was among healthy university presumably having more less similar activities (not recorded in this study) and living conditions. It is beyond the scope of this study to compare with diabetic and hypertensive individuals since this study was conducted only on healthy university students. This study remains inconclusive on certain parameters and can be furthered by assessing and comparing food/fluids intakes and to find out the association between total body water food/fluids intakes. Furthermore, the effect of physical activities levels could have been recorded among the respondents which is weakness of this study.

CONCLUSION

The present study indicates that Islamic fasting does not cause dehydration (reduction in TBW) in the fasting individual. The compensation of water during fasting appears to be due the burning of body fat to meet the energy requirement. The mechanism by which this happen is almost reversed in post Ramadan period.

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