Effect of Fasting on the Physical Effort of Pilgrims

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ملخص البحث (Abstract):

The current research was designed to investigate the effect of dawn-to-sunset Ramadan fasting on the generation of free radicals, which will arise as a result of the muscular efforts, which produced during the performance of Umrah, in different situations. 12 students performed Umrah in Al masjid Al Haram, by all its activity in different situations and under different environmental conditions. Each student participated to perform Umrah six times. All the participants collected urine sample just before starting Umrah and after finishing. Urinary MDA and urinary creatinine determined in all samples and MDA/creatinine ratio was obtained as an index for the generation of free radicals. There is a decrease in urinary MDA/ creatinine ratio after performing Umrah in comparison to that before performing Umrah in all groups of students in the non-fasting state, as well as, in fasting state for less than 6 hours whether in temperate or hot climate. On the contrary, in the fasting group for more than 12 hours there was an increase in urinary MDA/ creatinine ratio after performing Umrah in comparison to that before performing Umrah whether in temperate or hot climate. The results indicate that performing Umrah in fasting state for more than 12 hours at temperate or hot weather is exhausting as indicated by the increased production of MDA. However, performing Umrah in either non-fasting state or fasting state for at least 6 hours at temperate or hot weather did not increase the production of MDA. Furthermore, it decreases significantly the production of MDA. These results has pointed out that the exercise which is performed during Umrah is not a high intensity and exhaustive excersise. The sequence of the steps of Umrah in the holly mosque as described before make this exercise is adaptive and not injurious exercise. Moreover, drinking Zamzam water may increase antioxidant capacity of the body, but fasting for a long period may decrease this capacity.

Introduction:

Millions of Muslim people perform Umrah in Ramadan every year. Ramadan is the fasting month, and as all hugrian months it has no fixed weather seasons , as it may take place in summer , spring , winter or autumn seasons according to the year number. Therefore fasting in Ramadan may be in hot , moderate or cold weather according to the season.

In Umrah worship, according to its religious characteristics every person do certain physical effort in ritual of Umrah. Tawaf consists of circling the Kaaba seven times in an anticlockwise direction, and males are encouraged to do the first three rounds at a hurried pace, followed by the last four rounds, more closely, at a leisurely pace. A sa'i is a rapidly walking seven times back and forth between the hills of Safa and Marwah [1]. In some circumstances, The Tawaf and a sa'i are very crowded and make the Umrah very slow and very difficult. Therefore, the effort in the Umrah will be more

than in regular times. In Ramadan people perform Umrah at any time of the day, so they may be fasting or non-fasting. For many people the key question regarding performing Umrah during fasting in Ramdan is what is the effect of this effort on health. The answer to this requires a quick overview of what happens inside the body during fasting.

The changes that occur in the body in response to fasting depend on the length of continuity of fasting. Technically, the body enters into a fasting state eight hours or so after the last meal, when the gut finishes absorption of nutrients from the food.

During the fast, the storage of glucose is used up first to provide energy. Later in the fast, once the stores of glucose run out, fat becomes the next store source of energy for the body. As Ramadan fasting extends only from dawn till dusk, there is ample opportunity to replenish energy stores at pre-dawn and dusk meals. This provides a progressive gentle transition from using glucose to fat as the main source of energy, and prevents the breakdown of muscle for protein. Balanced food and fluid intake is important between fasts.[2]

Oxygen is required for all living organisms for their survival . But, at the same time, one has to remember that oxygen is base matter of free radicals development [3]. However, some of the oxygen is partially reduced to form free radicals or reactive oxygen species. Free radicals are any molecules "atoms" containing one or more unpaired electrons in an outer orbit. They come from smoking, pollution, fried foods and as a by-product of normal metabolism. Free radicals are extremely reactive. Their half-life is only a few milliseconds. When a free radical reacts with a normal compound, other free radicals are generated. This chain reaction leads to thousands of events. When free radicals overwhelm your antioxidant defenses, your cells are damaged. This damage is called oxidative stress [4].

The markers of oxidative stress are measured using variety of different assays. When a fatty acid is peroxidized it is broken down to aldehydes, which are excreted. Aldehydes such as thiobarbituric acid reacting substances (TBARS) have been widely accepted as a general marker of free radical production [5]. The most commonly measured TBARS is malondialdehyde (MDA) which is one of the most well- known products of lipid oxidation. It modifies both proteins and DNA and is the most mutagenic lipid oxidation product [6].

Malondialdehyde (MDA) has been found to be elevated under various conditions of oxidative stress, where ROS and RNS are considered to play important roles [7]. Now, the determination of plasma, urine, or other tissue MDA continues to be widely used as one of the best markers of oxidative stress.

It is widely accepted that strenuous exercise leads to an increase in reactive metabolites of oxygen capable of inducing cellular damage [8]. Increased oxygen flux and subsequent mitochondrial electron leakage has often been cited as the main source of free radical generation during exercise [8]. However, the contribution of this mechanism to the overall sum of free radicals produced during exercise has been widely debated, and it has been proposed that various mechanisms may work synergistically depending on the mode of exercise involved. Exercise intensity also plays a key role in the activation of other related and important mechanismsof free radical production such as substrate autoxidation, xanthine oxidase, intracellular calcium overload, and NADPH oxidase [9].

Lipid peroxidation is a well-defined mechanism of cellular damage in animals and plants. Lipid peroxides are unstable indicators of oxidative stress in cells that decompose to form more complex and reactive compounds such as Malondialdehyde (MDA) as natural biproducts of lipid peroxidation.

This research work was designed to investigate the effect of fasting on the generation of free radicals which will arise

due to the muscular efforts done during the performance of Umrah, in different situations.

Material & Methods:

Our students and their selected collages (21 to 23 Years old) performed Umrah in Al masjid Al Haram, by all its activity under different situations and environmental conditions.

All the students performed Umrah 6 times in different cases:

- Case (1): performed Umrah non-fasting in temperate climate (24°C)
- Case (2): performed Umrah during fasting for at least 6 hours in temperate climate (24 °C)
- Case (3): performed Umrah during fasting for at least 12 hours in temperate climate (24°C) .
- Case (4): performed Umrah non-fasting in hot climate (37°C).
- Case (5): performed Umrah during fasting for at least 6 hours in hot climate (37°C).
- Case (6): performed Umrah during fasting for at least 12 hours in hot climate (37°C).

Participants in all cases collected urine sample just before starting Umrah and after finishing . Urine samples collected in containers containing drops of 0.1 % HCl as preservative and kept frozen until time of analysis.

Urinary MDA and urinary creatinine determined in all samples to obtain MDA/creatinine ratio. The result statistically analyzed, and the obtained results tabulated and discussed.

MDA assay:

Urinary MDA was measured by Kit of OxiSelect™ TBARS Assay Kit (MDA Quantitation) from Cell Biolabs, Inc. from San Diego, CA 92126

Assay principle:

The Thiobarbituric Acid Reactive Substances (TBARS) assay kit is a tool for the direct quantitative measurement of MDA in biological samples. The unknown MDA containing samples or MDA standard are first reacted with TBA at 95 C°. After a brief incubation, the samples and standard can be read either spectrophotometrically or fluorometrically. The MDA content in unknown samples is determined by comparison with predetermined MDA standard curve.

Urinary creatinine was determined by SPINREACT Creatinine quantitative kit.

Principle:

The assay is based on the reaction of creatinine with sodium picrate. Creatinine reacts with alkaline picrate forming red complex. The time interval chosen for measurements avoids interferences from other serum constituents. The intensity of color formed is proportional to the creatinine concentration in the sample.

RESULTS:

The analysis of our results revealed the following points:

There is a decrease in urinary MDA/ creatinine ratio after performing Umrah in comparison to that before performing Umrah in all groups of students in the non-fasting condition and in the case of fasting for at least 6 hours whether in temperate or hot climate. This decrease is statistically non-significant ($p > 0.05$), although it is evident in about 66% of individual cases in every group.

On the contrary , in the fasting group for more than 12 hours there was increase in urinary MDA/ creatinine ratio after performing Umrah in comparison to that before performing Umrah whether in temperate or hot climate. This decrease

is statistically non-significant ($p > 0.05$), although it is evident in about 50% of individual cases in both groups. These results are summarized in table 1. and illustrated in figure 1.

When we compared the results of urinary MDA/ creatinine ratio in a combined group of students performing Umrah un-fasting and fasting for at least 6 hours in temperate climate and in hot climate (48 students) we found that there is a highly significant decrease in urinary MDA/ creatinine ratio in cases after performing Umrah in comparison to that before performing Umrah ($p< 0.006$) .

On the other hand when we compared the results of urinary MDA/ creatinine ratio in a combined group of students performing Umrah fasting for at least 12 hours in temperate climate and in hot climate (24 students) we found that there is a highly significant increase in urinary MDA/ creatinine ratio in cases after performing Umrah in comparison to that before performing Umrah ($p< 0.014$). (Table 2 & Fig 2)

Table 1 : Urinary MDA/Creatinine in all studied groups

	MDA/Creatinine in urine (µmol MDA/Mmol creatinine)			
Case		Mean	SD	P
1 Non fasting in temperate climate	Before	7.3	4.3	0.12
	After	5.9	3.5	
2 Fasting for at least 6 hours in temperate climate	Before	6.2	3.5	0.11
	After	4.9	2.3	
3 Fasting for at least 12 hours in temperate climate	Before	5.7	1.7	0.59
	After	6.1	2	
4 non fasting in hot climate	Before	7.2	2.8	0.66
	After	5.8	2.1	
5 Fasting for at least 6 hours in hot climate	Before	6	1.8	0.89
	After	5.9	2.2	
6 Fasting for at least 12 hours in hot climate	Before	5.2	1.5	0.88
	After	5.3	1.4	

Table 2: Comparison of Urinary MDA/Creatinine in different groups

	MDA/Creatinine in urine (µmol MDA/Mmol creatinine)			
Case		Mean	SD	P
Non fsting in temperate and hot climate	Before	7.3	3.5	0.014 *
	After	5.9	2.8	
Fasting for at least 6 hours in temperate and hot climate	Before	6.1	2.7	0.175
	After	5.3	2.3	
Fasting for at least 12 hours in temperate and hot climate	Before	5.5	1.6	0.594
	After	5.7	1.8	
Non-fasting and Fasting for at least 6 hours in temperate and hot climate	Before	6.7	3.2	0.006 **
	After	5.6	2.5	

non-significant ($p > 0.05$)

*** Significant** ($p < 0.05$)

**** Significant** ($p < 0.01$)

***** Significant** ($p < 0.001$)

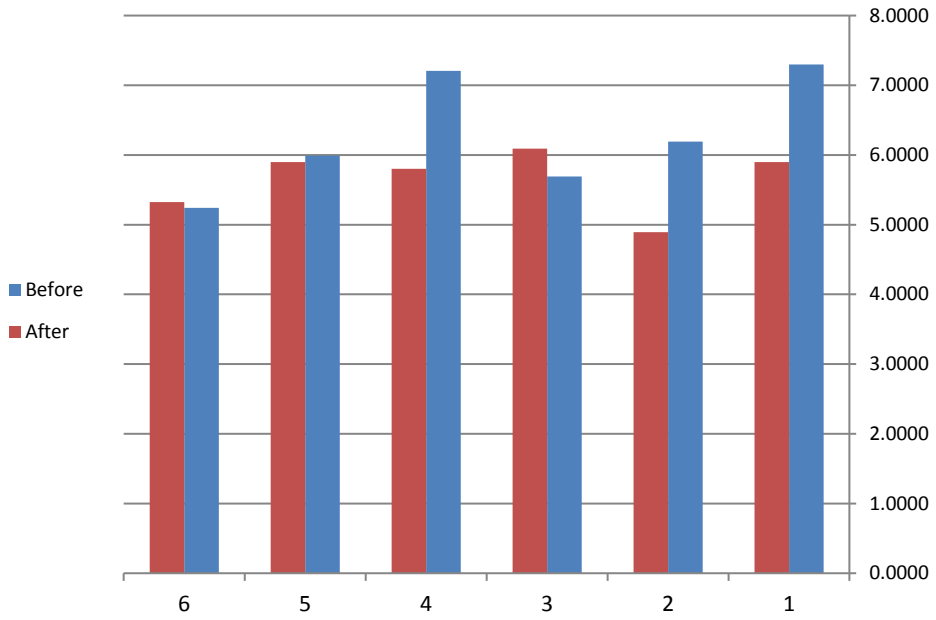

Fig. (1): Urinary MDA/creatinine before and after performance Umrah in all groups.

Performing Umrah

1: unfasting in moderate climate.

2: fasting 6 hours in moderate climate.

3: fasting 12 hours in moderate climate.

4: unfasting in hot climate.

5: fasting 6 hours in hot climate.

6: fasting 12 hours in hot climate.

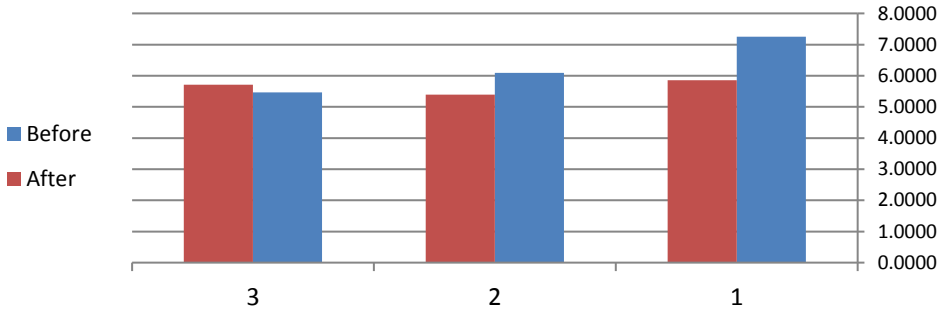

Fig. (2): Urinary MDA/creatinine before and after performance Umrah in different conditions 1. Non-fasting, 2= fasting 6 hours, 3= fasting 12 hours.

Discussion & conclusion:

Measuring the end products of lipid peroxidation is one of the most widely accepted assays for oxidative damage. A variety of oxidation products are found in urine and thought to mirror local and systemic oxidative stress. Malondialdehyde (MDA) is an indicator of lipid peroxidation which increases in various diseases. This increase is reflected in enhanced excretion of several MDA derivatives in the urine [10]. Many studies suggest that exercise-induced oxidative stress leads to increased free radicals and lipid peroxidation with resultant subcellular damage.

Regular training and conditioning mitigate the damage associated with free radicals and lipid peroxidation by promoting increased levels of superoxide dismutase and catalase. Some studies suggest an increased need for antioxidants in those athletes engaged in intensive training regimens. Evidence is emerging that antioxidants may have subtle effects on the exercise adaptive process [11].

It appears that the steps of performing Umrah is moderately intense physical exercise which increases oxygen utilization and causes excess oxygen-derived free radical liberation. free radical liberation occurs through mitochondrial lipid peroxidation, neutrophil degranulation and up-regulation of xanthine oxidase activity, which liberates superoxide [12].

Current results revealed that there is a decrease in urinary MDA/ creatinine ratio after performing Umrah in comparison to that before performing Umrah in all groups of students in the non-fasting satate and in the case of fasting for at least 6 hours whether in temperate or hot climate. In the fasting group for more than 12 hours, there was an increase in urinary MDA/ creatinine ratio after performing Umrah in comparison to that before performing Umrah whether in temperate or hot climate. Comparing the results of urinary MDA/ creatinine ratio in a combined group of students performing Umrah wether in non-fasting and fasting state for at least 6 hours either in temperate and hot climates (48 students), it has been found that there is a highly significant decrease in urinary MDA/ creatinine ratio in cases after performing Umrah in comparison to that before performing Umrah ($p< 0.006$). However, in the group of students performing Umrah in fasting state for at least 12 hours either in temperate and hot climates (24 students), it has been found that there is a highly significant increase in urinary MDA/ creatinine ratio in cases after performing Umrah in comparison to that before performing Umrah ($p< 0.014$).

These results indicate that performing Umrah with fasting for more than 12 hours at temperate or hot weather is exhausting as indicated by the increased production of MDA in contrast to performing Umrah in non-fasting or fasting state for at least 6 hours at temperate or hot weather where the production of urinary MDA is significantly decreased.

It was expected from the previous studies that urinary maldondialehde measured related to urinary creatinine will increase after performing Umrah in most people as pilgrims do much effort of muscle excerise during ritual Umrah [13].

Physical activity results in an increased production of free radicals and reactive oxygen species (ROS), and it is well known to induce oxidative stress in individuals subjected to intense exercise. In addition, during exercise, the process of delivering the oxygen to working muscles may actually result in oxidation of polyunsaturated fatty acids in the mitochondria. Furthermore, growing evidence implicates cytotoxic ROS as an underlying cause in exercise induced disturbances in muscle redox status that could result in muscle fatigue or injury [14].

Kelvin et al(1982) reported a two- to three-fold increase in free radical ($R^{\bullet}$) concentrations of muscle and liver following exercise to exhaustion. Exhaustive exercise also resulted in a decreased mitochondrial respiratory control, loss of sarcoplasmic reticulum (SR) and endoplasmic reticulum (ER) integrity, and increased levels of lipid peroxidation products [15]. Sojdin et al (1990) found that during exercise, two of the potentially harmful free radical generating sources are semiquinone in the mitochondria and xanthine oxidase in the capillary endothelial cells. During high intensity exercise the flow of oxygen through the skeletal muscle cells is greatly increased at the same time as the rate of ATP utilization that exceeds the rate of ATP generation. The metabolic stress in the cells causes several biochemical changes to occur, resulting in a markedly enhanced rate of production of oxygen free radicals from semiquinone and xanthine oxidase[16].

The obtained results revealed unexpected result as most of the participant in the study program showed a decrease in urinary maldondialehde ratio related to urinary creatinine after performing the ritual Umrah than that was present before performing Umrah except those who were fasting for more than 12 hours.

From current results, it has been shown that the exercise which is performed during Umrah is not a high intensity and exhaustive exsercise. The sequence of the steps of Umrah in the holly mosque as described before makes this exercise is adaptive and not injurious exercise. Furthermore, the emotional feeling of the pilgrims while they are performing the ritual Umrah may also share in decreasing the generation of free radicals. Drinking Zamzam water or other mineralized water may increase antioxidant capacity of the body, but fasting for a long period may decrease this capacity.

The long period of 12 hours fasting, the relative increase in temperature (afternoon), and the exhaustive efforts of muscle exercise collectively may caused the significant elevation in the urinary MDA after Umrah performance fasting for more than 12 hours.

This conclusion is supported by the results of study of Cooper et al (2002) which reviewed the role of free radicals in causing oxidative stress during exercise [17]. They found that high intensity exercise induces oxidative stress and although there is no evidence that this affects sporting performance in the short term, it may have longer term health consequences.

Venditti and Di Meo (1996) illustrated that physical training permits an animal to respond successfully to exercise loads of various types, intensities, and durations [18]. Furthermore, the trained animal can sustain the activity for a long period before the fatigue becomes limiting. The exhaustive exercise gave rise to tissue damage irrespective of the trained state.

Also our results can be explained by the study of Scott et al (2008). They reported that regular physical exercise has many health benefits including a decreased threat of all-cause mortality along with a reduced risk of cardiovascular disease, cancer, and diabetes [14]. Also Al-Shafei (2014) reported that Ramadan fasting ameliorates oxidative stress and improves glycemic control and lipid profile in diabetic patients[19], and ameliorates arterial pulse pressure and lipid profile, and alleviates oxidative stress in hypertensive patients[20].

The result of this study is preliminary one and there is a need to be supported by a study on a larger scale.

RECOMMENDATION:

There is a need to support the results of this study by performing it on larger scale. The role of physical exhaustion or deficient sleep before Umrah and its role in causing oxidative stress must be involved in this study.

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